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ABSTRACT

Part I of this report consists of the American Association for the Advancement of Science overview of research and development (R&D) in the fiscal year (FY) 1985 budget and its associated policy issues, together with special analyses of several important topics, such as funding for basic research. A set of overview tables is included. Part II presents seven chapters which review and analyze the proposed R&D budgets of major federal departments and agencies. They include the: Department of Defense; National Science Foundation; National Institutes of Health and Alcohol, Drug Abuse, and Mental Health Administration; Department of Energy; National Aeronautics and Space Administration; Department of Agriculture; and the Environmental Protection Agency. Tables showing details of the R&D budgets of these and several smaller agencies and departments not included in the chapters are provided. Ten chapters presenting cross-cutting analyses of the budgets by scientific and engineering disciplines comprise part III. These disciplines include social and behavioral science research, physics, astronomy, chemistry, atmospheric and oceanic sciences, mathematical and computer sciences, biology, chemical engineering, electrotechnology-related research, and materials science and engineering. Tables with data relevant to these disciplines are included when appropriate. (JN)

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AAAS REPORT IX:

RESEARCH & DEVELOPMENT, FY 1985

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AAAS REPORT IX:

RESEARCH & DEVELOPMENT, FY 1985

Intersociety Working Group

American Association for the Advancement of Science
1776 Massachusetts Avenue, NW, Washington, DC 20036

The AAAS Board of Directors, in accordance with Association policy, has approved publication of this report as a contribution to the understanding of an important process. The interpretations and conclusions are those of the authors and do not purport to represent the views of the Board or the Council of the Association.

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Intersociety Working Group

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American Institute of Aeronautics and Astronautics

American Institute of Biological Sciences

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American Meteorological Society

American Physical Society

American Psychological Association

Association of American Universities

Conference Board of the Mathematical Sciences

Federation of Materials Societies

Institute of Electrical and Electronics Engineers

National Association of State Universities and Land-Grant Colleges

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Preface

Publication of this report marks a major milestone in the AAAS-Intersociety R&D Budget Project.

The AAAS Committee on Science, Engineering and Public Policy initiated the project in 1976, commissioning Willis Shapley to write a report, Research and Development in the Federal Budget: FY 1977, and organizing a Colloquium on R&D Policy at which the report served as background. Both the report and the Colloquium were judged successful and the enterprise evolved into a continuing project, with the report published annually in early June, prior to the Colloquium.

In early 1978, six other organizations -- scientific, engineering and higher education associations -- joined with AAAS in adding another element to the project, a cooperative preliminary analysis of R&D in the federal budget. That analysis, published within about six weeks after release of the President's budget, was intended to provide information on R&D funding to policymakers in the Congress and the Executive Branch as well as members of the scientific, engineering and higher education communities in as timely a manner as possible during the Congressional budget process. Like the AAAS "June" report series and the annual R&D Colloquium, the "early bird" intersociety analysis has grown and matured considerably over the past several years.

Reflecting the expanded scope and maturity of the intersociety analysis -- and the increasing ability of working group members to turn out high quality work under more and more impossible deadlines -- we have decided this year to merge the "Preliminary Analysis" with the former AAAS "June" report, to publish this combined document in March under the title, AAAS Report IX: Research and Development, FY 1985, and to use it as background for the Ninth Annual AAAS Colloquium on R&D Policy, to be held in Washington, 29-30 March 1984, as well as for a variety of other purposes.

Part I of this volume consists of the AAAS overview of R&D in the FY 1985 budget and its associated policy issues, together with "special analyses" of several important topics, such as funding for basic research. A set of overview tables appears at the end of this part.

Part II includes seven chapters prepared by members of the Intersociety Working Group reviewing and analyzing the proposed R&D budgets of major federal departments and agencies. Tables prepared by AAAS showing details of the R&D budgets of all of these agencies -- as well as the budgets of several smaller agencies and departments not included in the chapters -- will be found at the end of Part II.

Ten chapters providing "cross-cutting" analyses of the budget by various scientific and engineering disciplines comprise Part III of the report. These analyses, which necessarily overlap in places, use as back-up data the overview and agency tables in Parts I and II, and most include additional tables with detail relevant to their disciplines.

While AAAS in its role as coordinator and the members of the Intersociety Working Group who prepared the individual chapters have made every effort to assure accuracy and consistency in the substance and format of this report, it should be noted that the chapters have been prepared largely independently of one another and under very tight deadline pressure. Some errors and inconsistencies are therefore unavoidable.

Readers of this report may also be interested in two publications to be released by AAAS later this year: the Proceedings of the Ninth Annual AAAS Colloquium on R&D Policy, "R&D in FY 1985: Budgets, Policies, Outlooks," to be published in June, and the follow-up budget report of the Intersociety Working Group, Congressional Action on R&D in the FY 1985 Budget, to be published in the fall or winter of 1984.

On behalf of the members of the Intersociety Working Group, we would like to express our appreciation to the officers, members and staffs of the 16 participating organizations for their support and assistance in the preparation of this report. A special note of thanks is due the AAAS Committee on Science, Engineering and Public Policy and its R&D Budget Subcommittee, whose members are listed elsewhere in this report, for their advice and assistance in the

conduct of this effort. We are also grateful to the individuals in OMB and other federal agencies, on Congressional staffs, and elsewhere who provided essential information and guidance. Finally, we stand in the debt of numerous secretaries in the participating organizations who toiled nights and weekends to deliver this manuscript to the printer on time -- and none more than Mary I. Haddock of the AAAS Office of Public Sector Programs.

Willis H. Shapley
Albert H. Teich
Jill H. Pace

Washington, D.C.
March 1984

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GENERAL NOTES

BASIS OF BUDGET STATISTICS

Budget statistics are presented on three bases: (1) budget authority, corresponding to the funds appropriated each year; (2) obligations, indicating the amounts of contracts and grants entered into; and (3) outlays, representing the amounts actually expended. Because budget decisions in the Executive Branch and in Congress are almost always made in budget authority, this basis most accurately reflects current changes in budget policies. Outlay trends lag a year or more behind decisions in budget authority, and obligations estimates are often adjusted to meet fiscal or budget strategy demands. We have, therefore, selected budget authority as the most meaningful measure of budget decisions and trends and used it in nearly all cases throughout the report.

BASIC RESEARCH, APPLIED RESEARCH, AND DEVELOPMENT

The allocation of agency budgets among basic research, applied research, and development is not an exact procedure; a certain arbitrariness is inevitably involved. The severe time pressures under which these figures are compiled for "Special Analysis K" also are a problem. Nevertheless, there is presumably some consistency within each agency's estimates so that the trends are meaningful.

ROUNDING ERRORS

Due to rounding in the tables, the detail may not add to the totals and the percentage changes may not correspond exactly to the differences shown.

Part I: Overview

Chapter 1

Overview and Policy Issues

American Association for the Advancement of Science
Willis H. Shapley, Albert H. Teich, Jill H. Pace

The numbers for research and development in the FY 1985 budget are impressive. Total budget authority for R&D is up 18 percent over FY 1984 to $54 billion; total outlays are up 15 percent to $50 billion. Basic research funding is up about 10 percent and approaching $8 billion. There are some new initiatives -- in space, physics, astronomy, and elsewhere. There is strong policy support for basic research as the foundation for a strong defense, industrial leadership, new jobs, and improved quality of life in years to come.

It is a strong budget for R&D, but analysis of the totals raises questions. The big increase is almost entirely on the military side. Total non-defense R&D budget authority increases only about as much as inflation. There are sizeable increases in NASA, NSF, and elsewhere, but significant cutbacks in energy R&D, NOAA, and other programs. There are larger increases for research in the physical sciences and engineering than for biological and medical sciences. Several programs in areas considered to be private sector responsibilities are again recommended for drastic cuts or termination. These and other questions raised by the FY 1985 budget recommendations for R&D will be addressed in this report.

Questions on the R&D spending plans in the FY 1985 budget are overshadowed, however, by the need for drastic actions to reduce the deficit. Beneath the political posturing on both sides there is a realization that something has to be done. Even if some tax increases are agreed to, one or more rounds of expenditure cutbacks are

clearly in the offing, either in a deficit-reducing package in 1984 or in a new attack on the deficit after the election in the first months of 1985.

For R&D, therefore, the fundamental question is how R&D budgets will (or should) be treated in another Stockman-style resizing of the federal budget. This grim prospect results not from problems internal or peculiar to R&D, but from the basic flaw that invalidates the total FY 1985 budget.

The expenditure side of the FY 1985 budget clearly reflects the policies of the Reagan Administration: a continuation of the large build-up in the defense budget and a tight rein holding growth in non-defense spending to little more than the rate of inflation. On the revenue side it reaffirms the President's long-standing opposition to tax increases. Its economic assumptions are optimistic projections of renewed growth, declining unemployment, and relatively low interest and inflation rates. The bottom line, however, is a continuing pattern of deficits in FY 1985 and succeeding years which the administration itself agrees is unacceptable and incompatible with the economic assumptions on which the rest of the budget is based.

Thus, the FY 1985 budget is not a budget in the traditional sense of the President's plan for dealing with the problems of the nation. It is instead a statement of the problem, with the answers left up in the air -- to be found in bipartisan negotiations with Congress, unilateral Congressional actions, or a new Presidential initiative some time after the election. However it comes, the answer will result in a new budget, markedly different from the present FY 1985 budget. Some combination of tax increases, other new revenues and major surgery on the expenditure side seems inevitable.

In this situation, we must regard the overall spending proposals in the FY 1985 budget, including the amounts proposed for R&D, not as firm plans but as baselines from which changes are likely to be made. The FY 1985 budget is still worth study and analysis but we must keep coming back to the hard and perhaps unanswerable question of what will or should happen when cutbacks are made to reduce the deficit.

A. The Total Budget and R&D

Table I-1 shows the composition of the total outlays proposed in the FY 1985 budget. The increases for national defense and interest on the public debt, and the hold-the-line policy on non-defense outlays are clearly evident. For R&D, it is noteworthy that the rate of increase in national defense R&D outlays is 50 percent higher than the rate of increase for total outlays for national defense. Non-defense R&D outlays, however, are constrained even more severely than other categories of non-defense outlays.

Table I-2 presents the projections for FY 1987 and FY 1989 shown in or implied by the FY 1985 budget, for the same categories of outlays as Table I-1. Long-range budget projections are seldom reliable guides to the future and these projections are especially untrustworthy because of the unreality of the FY 1985 budget on which they are based. Nevertheless, they serve to illustrate the "best case" of the horrendous problem of the deficit. Even with the smaller defense increases projected in the outyears, continued tight constraints on non-defense spending, and rosy economic assumptions, the administration's projected deficit would still come to $123 billion in FY 1989. Other forecasters using less rosy assumptions -- notably the Congressional Budget Office -- see the FY 1985 budget as implying deficits well over $200 billion a year in FY 1986 and indefinitely into the future.

Table I-2 also gives an idea on how R&D fits into the administration's "best case" outlay projections. The future projections printed in the budget for the major R&D accounts are mostly figures "plugged in" at the FY 1985 levels, with or without allowances for inflation, but there are two significant exceptions. The official Department of Defense (DOD) five year plan figures show a distinct flattening out of the annual rate of increase in DOD R&D in FY 1986 and FY 1987, and a further flattening out in FY 1988 and FY 1989 is clearly implied by the published total DOD projections for these years. For NASA, the administration has made a commitment, as a part of the President's decision to develop a space station, to provide a 1 percent per year increase (after inflation) in the total NASA budget. This would

*Tables for this chapter appear at the end of Part I (pp. 29 to 45).

permit NASA expenditures for R&D to increase at an even greater rate because the portion of the NASA budget needed to subsidize space shuttle operations is expected to decline as more of the costs are covered by customer reimbursements.

If all these projections come true, total R&D outlays would level off only slightly above the FY 1985 level in constant dollar terms. Nevertheless, R&D will continue to be in an exposed position for deficit control budget cutting: defense R&D because it is a "controllable" part of the largest single "controllable" class of expenditures in the budget, and non-defense R&D because it represents such a large "controllable" fraction (20 percent) of total expenditures for non-defense programs other than payments and grants.

B. R&D in the FY 1985 Budget

Table I-3 presents the total estimates of budget authority for R&D in the FY 1985 budget, in current and constant dollars and broken down between the national defense and non-defense categories. The figures shown are the budget authority counterparts for the obligations and outlays figures published in "Special Analysis K" of the FY 1985 budget, with corrections subsequently found necessary in the estimates for Department of Energy R&D. The budget authority estimates are compared to the estimates for obligations and outlays in Table I-4. The trends in budget authority in the FY 1985 budget correspond closely to those we saw for outlays in Table I-1: continuing large increases in the national defense category (which includes Department of Energy defense-oriented R&D as well as DOD R&D) and a total for non-defense that is essentially level in constant dollar terms.

Table I-5 breaks down the total for non-defense R&D into its principal functional components and shows the trends over a longer period. Space R&D shows two sharp declines, one after the peak funding for the Apollo program in the late sixties, and another when the space shuttle moved from R&D into operational status in FY 1982. Since that time funding for space R&D has begun to increase as funds for new starts in space sciences and now for the space station project have been included in the FY 1984 and FY 1985 budgets. Health R&D shows significant steady growth from

FY 1967 to 1984. The FY 1985 budget figures show a much smaller rate of increase, actually a decline in constant dollars, reflecting either a lower priority by the administration for biomedical research or the traditional "low balling" of the NIH budget, as discussed later in this report. Energy R&D peaked at the beginning of the 1980's but has declined sharply and steadily since 1981 under the Reagan Administration policies declaring much of DOE's former energy development and demonstration activities as not appropriate for federal funding. Our general science category (NSF and general science in DOE) shows continuous steady growth in both current and constant dollars over the whole period 1967-1985, although the rate of growth is somewhat blurred in Table I-5 because of rounding. The all other figures reflect the combined net changes in funding for all civil R&D not covered in the preceding categories.

Tables I-6 and I-7 show breakdowns of total R&D funding into the conventional NSF categories of basic research, applied research, development, and R&D facilities. Table I-6 shows the long-term historical pattern, in which funding for basic research is seen to have increased since FY 1967 to a substantially greater degree than funding for applied research or development. Table I-7 indicates, among other things, that on the non-defense side more money is going to basic research than to either applied research or development. This results from the policy of steady increases in basic research combined with the cutbacks in energy applied research and development and the transition of the space shuttle from developmental to operational status.

Finally, in this series of overview tables, Table I-8 summarizes the amounts for R&D in the FY 1985 budgets of the principal R&D agencies of the federal government. Detailed discussions of the R&D budgets of these agencies are given in Part II of this report. Here are a few agency highlights:

Department of Defense. A 27 percent ($7.5 billion) increase is proposed, with a major new surge in advanced technology development. Basic research is slated for a 10.7 percent boost. In constant dollars, total DOD R&D has now regained and passed its previous peak in the 1960's, and DOD basic research is reaching two-thirds of its 1960's high water mark.

NASA. R&D in NASA is up substantially, with two major scientific new starts and $150 million to begin development of a space station expected to cost $8 to $20 billion over the next decade.

Department of Energy. Continuing increases in defense atomic energy R&D, a big increase in general science (largely high energy and nuclear physics), and cutbacks in applied research and development on non-nuclear energy systems are again in FY 1985 the main features of the Reagan Administration's R&D budgets for DOE.

National Science Foundation. NSF is again favored, with a 14.4 percent increase for the R&D activities it supports. The increase is again weighted in favor of the physical sciences and engineering.

National Institutes of Health. NIH is given only a token 2.2 percent increase, presumably because the administration again expects Congress to add its customary healthy increase to whatever amount is put in the budget.

Agriculture. Total R&D is not increased, but provision is included for an increase in the competitive research grants program, including a new basic research program in agricultural biotechnology.

Education. R&D programs in Education are slated for about a 3 percent drop. The National Institute of Education receives a modest increase (12.4 percent to $54.2 million) after several years of cuts, but remains slightly below its FY 1983 level, while other programs, including R&D for the handicapped, are reduced.

Environmental Protection Agency. EPA gets a 12.7 percent increase in R&D funding as a part of the new look at EPA following the upheavals of 1983.

National Oceanic & Atmospheric Administration. NOAA again gets the most severe budget cut in R&D. Most of the reductions are based on the premise that the work should be done and paid for in the private sector or state and local governments. Some of the reductions, like elimination of the Sea Grant program, are proposed by the administration and automatically restored by Congress each year in what seems to be becoming an annual NIH-style ritual.

National Bureau of Standards. Total R&D increases slightly, but operating funds drop 4 percent to $91.2 million. The budget proposes to terminate funding for the Center for Building Technology and for the Center for Fire Research. Congress rejected similar proposals in the FY 1984 budget.

U.S. Geological Survey. R&D programs under USGS drop by 9 percent, to $148.1 million. Reductions would occur in water use programs, cooperative data collection efforts, and core research activities; funds for the Water Resources Research Institutes and for federal coal hydrology investigations would be eliminated.

Bureau of Mines. The FY 1985 budget for the Bureau of Mines cuts R&D activities by 21 percent. Funding for the Mineral Institutes is eliminated, and support for programs in health and safety technology and conservation and development is reduced.

C. R&D Policies in the FY 1985 Budget

During the Reagan Administration's first three years in office, policies on science and technology -- as expressed in leadership statements and budget decisions -- have evolved from their original sharp attacks on the prevailing expectations of the scientific and technical establishment to more benign, largely non-controversial general policy statements and a budget for FY 1985 which should gratify most of the major scientific and technical constituencies. The R&D issues that remain seem to be more with some of the specific applications of the policies than with the policies themselves.

Much of the administration's initial policy outlook on science and technology was determined by its ideology and overall economic policies. The big budget cuts of 1981, the curtailment of the federal role in favor of the private sector, and the attack on the social sciences were the product of general policies and attitudes, not of a new science policy as such. When the administration came to formulating its own science and technology policies, the directions had already been set. The President's Science Adviser's early stress on excellence and selectivity and opposition to fixed percentage budget growth were policies that served both to rationalize the budget cuts already made and to set the tone of the science adviser as a critic of the scientific establishment, not its spokesman.

But as the administration has made the usual transition from critic of the establishment to being itself the establishment, the rough edges have been rounded. Current general policy statements on science and technology are not materially different, except in rhetoric, from those of previous administrations. With the major exception of the more restrictive interpretation of the proper role of the federal government in civilian R&D, especially energy R&D, the administration's budget decisions are now pointing the major areas of R&D -- defense, basic research, space, and health -- in the same generally upward directions they were headed before the Reagan Administration took office. Things have really looked up for R&D in the Reagan Administration since the dark days of the threat of a 12 percent second round of budget cuts in the fall of 1981.

Some of the nuances in current Reagan Administration science and technology policies as presented in conjunction with the FY 1985 budget can be summarized as follows:

Basic research is extolled as "the foundation for the achievement of long-term national objectives of a strong defense, economic security, and an enhanced quality of life." Addition of the last phrase broadens the defense-economic development focus of earlier justifications for basic research. The importance of people and "excellence" are stressed; this seems to be mostly hortatory guidance to federal program managers -- the young investigator and science and mathematics teaching awards are its chief concrete manifestations. There is apparently still a policy tilt in favor of basic research in physical science and engineering, but it is muted this year and no longer implies over-emphasis on biomedical research. Cooperative basic research by industry and universities continues to be encouraged. (For more details on basic research, see Chapter 2.)

Federal Role in R&D. Current policy statements continue to stress a more careful delineation of the respective roles of the federal government and the private sector in R&D. The latest statements seem less doctrinaire than earlier ones and broaden the areas of R&D appropriate for federal support. For example, federal support of "long-term applied research" as well as basic research is now acceptable, as are "R&D activities that improve the quality of life or

support the Nation's long-term economic strength and are of such a nature that private firms or consortia acting alone cannot realize a sufficient return to warrant investment in them."[1]

Science Education: Policy in this area seems still to be hesitant and ambivalent. The administration apparently accepts the existence of serious problems and applauds the "mounting public determination to improve the educational systems that are preparing young people to take their places in tomorrow's world of high technology."[2] But Congressional increases in the NSF science education budget are only reluctantly accepted and the major recommendations of the National Science Board and the Commission on Excellence in Education are not being implemented.

D. The Major Issues

As we have seen, the most serious issue facing R&D in the FY 1985 budget is its vulnerability to major cutbacks in actions necessary to reduce the deficit. All who recognize the long-term importance of a strong, broad, continuing national effort in R&D will face some difficult strategic decisions when, as is likely, there is a concerted national effort to resize the federal budget to cut back the deficit.

Should we fight as hard as possible to preserve the preferred treatment R&D has in the FY 1985 budget and let the hurly-burly of the political process determine the results? Or should the scientific and technical community try to help set the priorities for resizing federal support of R&D at a lower level? Should every discipline and field of R&D go out to get all it can in a dog-eat-dog fight with the others or is it to the advantage of all to band together in a unified approach? Is the scientific and technical community capable of organizing itself to prepare its position in advance, or will it react only to a direct threat of imminent action?

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[1] Office of Science and Technology Policy in cooperation with the National Science Foundation, Annual Science and Technology Report to the Congress: 1982 (Washington, D.C.: U.S. Government Printing Office, 1983).

[2] Office of Science and Technology Policy, "Administration Proposes $6.4 Billion Increase in Federal Research and Development for Fiscal Year 1985," press release (Feb. 1, 1984), p. 3.

Apart from this overriding, but for now intangible issue, there are other issues with respect to R&D in the FY 1985 budget, if one takes it at face value and assumes a normal passage through the Congressional budget process. Many such issues are discussed in the body of this report; here we highlight four:

1. The defense build-up: The magnitude of the continuing build-up in defense R&D raises the question of whether the total program that has been started will require a totally unrealistic, perhaps exponential rate of growth in the budget to sustain itself. Even though DOD's multi-year plans show a flattening in the rate of increase, history strongly suggests that cost increases, delays, and overruns will demand ever-increasing total appropriations for R&D. The problem is undoubtedly aggravated by the almost automatic large reductions in the planned budget increases that Congress makes each year. One would hope for clearer indications from the DOD leadership that the program can be carried out within an overall funding envelope that is acceptable to Congress.

2. The basic research build-up: The continuing build-up in basic research funding for NSF and other agencies is a welcome feature of the FY 1985 budget. As discussed in Chapter 2, if Congress approves the budget recommendations plus its usual augmentation for the National Institutes of Health, the real growth rate will be about 10 percent. This happy possibility, however, does raise the questions on the impact of the increases and what the scientific and university communities should expect and plan on for the future.

Do the increases imply a real expansion of the nation's infrastructure at universities and elsewhere for conducting basic research? Or are the increases -- to date anyway -- illusory, in the sense that they are needed to operate and preserve the infrastructure we now have? If they are "real real" increases, what plans should our basic research institutions make for the future? Should they count on continued real growth for the indefinite future? What are the implications for the supply and training of high quality investigators?

It is easy to say that these are problems the scientific community should be glad to have, especially in the shadow

of the deficit. But since there is the possibility that the FY 1985 increases in basic research -- and perhaps even further increases in future years -- may actually materialize, the questions deserve thought and discussion.

3. NASA and the Space Station: President Reagan's decision that NASA should proceed to develop a permanently manned space station within a decade and to request $150 million in the FY 1985 budget for definition, design and other preliminary work, will automatically become a major R&D issue in the FY 1985 budget. Any multibillion dollar discretionary project is fair game for budget cutters, even when deficit control is not a central concern. And even when such a project is brought within an acceptable total budget, it becomes a target for other claimants who believe their unmet needs or aspirations deserve a higher priority.

The scientific community tends to be especially nervous about large scale new initiatives in space. Traditionally this has been based on the belief that the money spent on projects like Apollo and the Space Shuttle has been diverted from science projects in which the scientists are more directly interested. While there is now wider recognition that the manned space flight and space science budgets go on separate decision tracks, there can still be legitimate concerns that once a commitment is made to a large long-term advanced technology project like a space station, there will inevitably be schedule delays and cost increases that will put a squeeze on the rest of the budget and science will suffer.

Apart from its vulnerability on purely fiscal grounds, the issues raised by the space station are somewhat intangible and not likely to be settled or even clearly joined in the consideration of the FY 1985 budget. The program is being presented not as a specific project with clearly defined objectives, but essentially as a useful and necessary next step in the development of capabilities and infrastructure for human activity in space. The fundamental questions are whether we should continue or give up on expanding human activity in space, and whether now is the time to proceed with the next step.

These basic questions do not have to be finally resolved in actions on the FY 1985 budget. The FY 1985 budget proposal is mainly for design and definition, and there will be opportunities for go no-go decisions in future years. The

concerns about the commitment to large future costs will be partly defused by the modular approach proposed which does not require a "crash" program to meet a fixed schedule. The concerns about the impacts on other programs have been anticipated by the administration's commitment to 1 percent per year real growth in the total NASA budget, which would permit a much larger rate of growth in NASA R&D activities as space shuttle R&D winds down and shuttle operational subsidies are increasingly replaced by customer reimbursements.

Even if this is not the year of decision for the space station, the issues deserve careful consideration as the planning proceeds and the degree and implications of future fiscal constraints become clearer.

4. Moving R&D to the Private Sector: One of the most troublesome generic problems in federal R&D is the implementation of the policy that applied research and development for non-governmental purposes should be done and paid for by the private sector (or other non-federal government entities) unless there are compelling reasons to the contrary. The policy is not new, but the problems have become more acute because the present administration has taken a more restrictive view of the government's role and a more aggressive stance in weeding out federal support of R&D that do not meet their criteria.

In addition to basic questions on the merits of the policy itself -- in general or in particular areas -- there are some difficult problems in implementing shifts of funding responsibility from the federal government to the private sector.

Cutting an R&D program out of the federal budget does not automatically result in the private sector taking it over. The economic incentives may not be sufficient, or the private sector may not be organized to take advantage of them. The private sector may simply not believe that the government will actually discontinue programs it has carried on for many years.

It seems essential, therefore, that two fundamental questions be faced in each case where a cutback in federal R&D is proposed because the R&D should be funded by the private sector: Will the private sector in fact support R&D equivalent to what is being cut from the federal budget? If

this is in doubt, is the outcome -- i.e., that the R&D may not be done at all -- acceptable in the national interest?

These questions deserve careful examination for each of the R&D cutbacks in the FY 1985 budget based on the inappropriateness of federal rather than private or other non-federal support. A partial listing of programs affected includes: numerous DOE energy R&D programs, the NASA advanced communications test satellite, the Centers for Building Technology and Fire Research in the Bureau of Standards, some ocean research programs in NOAA, and the Minerals Institutes in the Bureau of Mines.

Chapter 2

Special Analyses

American Association for the Advancement of Science
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This chapter provides information on policy and funding trends in several important areas: federal funding for basic research, federal support for R&D at colleges and universities, and R&D in industry. In addition, it includes a brief discussion of the most recent data on total national expenditures for R&D, by both source of funds and performer. Tables on which these discussions are based will be found at the end of Part I.

A. Basic Research

The Reagan Administration continues to place heavy emphasis on federal support for basic research, particularly in the physical sciences, mathematics and engineering -- areas which it sees as making important long-term contributions to the nation's economic vitality and national security. Basic research in the federal government would reach a total of more than $7.6 billion under the proposed FY 1985 budget, an increase of 9.4 percent in current dollars, or 4.5 percent in constant dollars over FY 1984. This increase -- which may well rise a bit further if Congress adds to the NIH budget as most observers expect -- follows an 11.5 percent increase (6.7 percent in constant dollars) between FY 1983 and FY 1984. Table I-9 displays the amounts for conduct of basic research by agency, based on OMB and agency estimates contained in the FY 1985 budget.

The substantial increase in federal funding of basic research combined with the sharp cutbacks in support for civilian applied research and development accomplished by the Reagan Administration have helped change the character of the non-defense side of the federal R&D program. In the

past, development has constituted the largest portion of non-defense R&D, while basic research has been the smallest part. In the FY 1985 budget the situation is different. Basic research represents 43 percent of non-defense R&D, applied research is 36 percent, and development is down to only 22 percent. (See Table I-7.)

Presidential Science Adviser George Keyworth made a strong point of these statistics at his budget press conference in February 1984, noting that:

> Over the past four years we've drastically reduced funds for the kinds of demonstration projects that industry can pursue better as well as for other non-defense development; at the same time we've created a strong base for our long-term economic vitality by bringing basic research from the smallest to the largest component of non-military R&D funding.

The fact that the administration has managed to achieve significant real growth for basic research in the midst of a major austerity program in non-defense spending should certainly not be minimized. It should be noted, however, that the relative proportions of basic research, applied research, and development in non-defense R&D have been influenced not only by cutbacks in demonstration projects but at least as much by last year's reclassification of the space shuttle program (which was the biggest single component of non-defense development) as an operational program rather than an R&D program. Thus the change is in part a statistical artifact.

Although the text of OMB's "Special Analysis K" notes the high priority the administration "continues to give to support for basic research across all disciplines," the emphasis is still strongest in the physical sciences and engineering, with major increases for such agencies as NASA (20.0 percent), DOE (12.7 percent), NSF (13.5 percent), and DOD (10.7 percent), and smaller increases for NIH (5.0 percent) and Agriculture (8.8 percent). As the disciplinary analyses in Part III of this volume reveal, basic research in fields such as physics, mathematics, and computer

sciences is favored within federal agencies. Worth noting, however, is the fact that in describing the "long-term national objectives" to which basic research contributes, OMB has chosen to add "an enhanced quality of life" to the "strong defense" and "economic security" rationales which have been cited as the basis for the government's role in support of science during the past couple of years. This seems to mark a slight change in the tenor of the administration's approach to basic research. It also should be remembered that the administration has, by all accounts, deliberately set the NIH budget low in the expectation that Congress will increase it.

Included in the budget are a number of major basic research initiatives:

- In NASA, the Mars orbiter and upper atmosphere research satellite;
- In DOE, the beginning of construction of a new electron accelerator at Newport News, Virginia and the initiation of preliminary R&D on a Superconducting Super Collider;
- In NSF, a new program of support for cross-disciplinary research in engineering at universities and the beginning of construction of the Very Long Baseline Array radiotelescope; and
- In Agriculture, a new grants program in agricultural biotechnology.

These are significant commitments and could be interpreted as signalling the administration's intention to continue strong support for basic research in future years, despite the prospect of continued deficits and austerity for the nondefense side of the budget. On the other hand, if basic research funding is squeezed over the next few years, the run-out costs of these programs, together with the space station, could exert significant downward pressure on other areas of basic research.

Several caveats apply to the federal basic research statistics presented here. First of all, decisions on R&D funding are generally made within agencies and OMB in terms of programs, missions, and organizational units, rather than in terms of "basic research," "applied research," and

"development." The R&D figures in our tables are reported to OMB in a separate exercise under strong time pressures. Differences in judgments among agency officials, together with imprecise and changing definitions of what is to be classified in each category, often lead to inconsistencies.

In addition, there are some specific items that affect the basic research figures in this year's budget. These include:

- The treatment of funds for basic research facilities and construction. These funds are not included in our basic research figures, which show only conduct of basic research. Including them would add about $300 million to DOE's FY 1985 basic research figure (and analogous amounts to prior years), due to ongoing construction of several accelerator facilities. The estimate of basic research in NASA would also be increased significantly if one were to include a proportionate share of the launch and operations costs supporting it.

- Reclassification of R&D in HHS/NIH. This agency has apparently changed the basis on which it classifies its R&D as basic research, applied research, or development, resulting in an increase of about $300 million in the share of HHS's FY 1985 R&D considered to be basic research. The FY 1983-85 figures shown in Table I-9 are consistent with one another, but prior years are not.

- Basic research in DOD. In prior years, basic research in DOD has been synonymous with the "Research" or the "6.1" budget category. In FY 1985, the figure shown includes $30 million from the "Advanced Technology Development," or "6.3A" program. This is reported to be associated with the space-based laser defense system (the "star wars" program).

B. Colleges and Universities

The administration's efforts to boost the level of federally-funded basic research are, of course, closely tied to its interest in the welfare of science and engineering at colleges and universities. These institutions have

historically performed, and continue to perform, the largest share of the nation's basic research. Basic research at colleges and universities is also linked to the education and training of scientists and engineers, particularly at the graduate level, and this is a subject of continuing concern for federal policymakers.

The OSTP press release on the FY 1985 budget notes the "key role" that universities play in basic research and cites the major increase in basic research funding to universities that has taken place under the Reagan Administration. Our own table, showing support for all forms of R&D, not just basic research, at colleges and universities by agency (Table I-10) supports the general impression of an increase, but suggests that it may not be as dramatic as implied by OSTP. This table is based on data collected by OMB in connection with "Special Analysis K" for the FY 1985 budget. It should be treated with some caution, since it reflects not programmatic decisions but estimates by agency officials of the amounts they would spend for R&D at colleges and universities under their requested budgets.

As Table I-10 shows, estimated support for R&D at colleges and universities would reach nearly $6.0 billion in FY 1985 under the proposed budget. This is an increase of 5.5 percent over FY 1984 and would just offset the effects of anticipated inflation during the year. During the period FY 1982-FY 1985, R&D at colleges and universities would grow by 29.9 percent, which translates into a 13.4 percent increase when the effects of inflation are taken into account. This may, of course, rise a bit more if Congress treats NIH kindly. While respectable, it is hardly a cause for rejoicing in academe -- particularly in view of the cutbacks in other forms of federal support to higher education.

It is interesting, too, to note the apparent divergence in the trend-lines for federal funding of basic research and federal funding of R&D at colleges and universities. In general, because of the close association between basic research and higher education, one would expect these trends to parallel one another. Between FY 1982 and FY 1985, however, federal basic research would grow 27.2 percent in constant dollars, more than twice the projected growth rate of federal support for R&D at colleges and universities (13.4 percent, as noted above).

In part, this divergence probably reflects the impacts on universities of cutbacks in federal non-defense applied research and development programs, such as those of DOE. In addition, it may also be a function of the growing role of non-university basic research programs, including those at astronomical observatories, particle accelerators, and similar user-oriented facilities operated outside of universities by national laboratories, university consortia, and the like. In many respects, these establishments serve as extensions of academia and college and university faculty and students participate actively in their programs. No estimate is available of how much would be added to the figures for federal funding of college and university R&D by including a share of the construction and operating costs of such facilities, but it would likely be substantial.

As Table I-10 indicates, NSF would provide the largest percentage increase in support for R&D at colleges and universities, 14.7 percent to $1,068 million. Other agencies showing substantial growth include DOD (up 11.5 percent to $996 million) and NASA (up 11.9 percent to $235 million). DOE and Agriculture would post modest gains, while the largest supporter of college and university R&D, the Department of Health and Human Services (mainly NIH), would increase its support by only 2.5 percent (a loss of 2.1 percent in constant dollars) -- unless Congress comes to the rescue. Several agencies which provide smaller amounts of support, including AID, Education and Commerce show significant drops. In the case of Commerce, the drop apparently reflects the proposed termination of the Sea Grant Program, a move Congress has rejected for the past three years.

Despite the fairly wide spread of increases and decreases among agencies displayed in Table I-10, the shares of various agencies in total federal support for R&D at colleges and universities would remain relatively stable. HHS would continue to support nearly half (47 percent, down from 48 percent in FY 1983 and FY 1984); NSF's share would be up very slightly to 18 percent and DOD would go up a point to 17 percent; DOE, Agriculture and NASA would retain more or less the same shares -- 6,5 and 4 percent respectively.

Two final points relating to college and university R&D bear mention here: First, several federal agencies are continuing to devote special attention to funding for

research instrumentation at colleges and universities. NSF, as described in the chapter on that agency in Part II of this volume, expects to spend $237 million on instrumentation and faciiities in FY 1985, an increase of 20 percent over last year and 97 percent over FY 1983. About half of this will be through individual project proposals. DOE has allocated $6.0 million to its program of university research instrumentation, up 50 percent from FY 1984. And within DOD, each of the three services has reserved $10 million of its basic research funding (the same as in FY 1983 and FY 1984) for a dedicated program of university instrumentation.

Second, NSF, whose Congressional allies managed to thwart two attempts to legislate special set-asides for research at undergraduate and non-Ph.D.-granting institutions during the last session, is devoting more attention to these institutions this year. No line-item is presented for FY 1985, in keeping with NSF Director Knapp's aversion to targetted programs. However, the Foundation has appointed a special coordinator to work with program officers in its research divisions in facilitating proposals from such institutions. NSF estimates that support for research at predominantly undergraduate institutions will increase by 15.2 percent, to $42.4 million in FY 1985. Many observers have felt that since these institutions provide undergraduate training for a significant share of the nation's leading scientists and engineers, they deserve greater attention from NSF than they have received in the past.

C. R&D in Industry

Pending the availability of a consistent set of updated statistics from NSF, it is not possible to say much with confidence about the current overall trends and composition of R&D in industry. Extrapolations into 1984 of data for recent years are especially risky at this time because of the uncertain impacts on R&D of the economy moving first into and then out of a recession.

As we see in Table I-11, the currently available national R&D estimates show total industry funding of R&D as continuing to increase in 1984. There are many uncertainties in these estimates, however, which will not be resolved until data on what is actually happening in 1984 is avail-

able. The best comprehensive forecast, which has the merit of distinguishing different trends in different segments of industry, is in a special study by NSF based on interviews with industry officials from March to July 1983, and published in Science Resources Studies Highlights (NSF 83-327) dated December 15, 1983.

The NSF forecasts based on this survey show the same 11 percent growth in total industry funding of R&D as the estimates in Table I-11. NSF's analysis of its estimates show that above average R&D growth rates are expected in 1984 in the medical and scientific instrument industry (23 percent), computer companies (20 percent), drug companies (16 percent), and the aircraft industry (13 percent). Near or slightly below average growth in 1984 is expected in the photographic equipment industry (12 percent), electrical and communications equipment (11 percent), and in the chemical industry, in which there is much variation but an average increase of only 9-10 percent. The lowest expected 1984 R&D growth rates identified by NSF were for the motor vehicle industry (5 percent) and the non-computer machinery industry ("only slight"). In general the NSF study found that R&D-intensive industries are continuing to increase their expenditures for R&D and expect to make greater increases in 1984 than in 1983. The question remains open, however, whether the trends that industry spokesmen were projecting in 1983 are actually materializing in 1984.

Some similar data on R&D by industrial sector are contained in Table I-13, which is based on the most recent of Business Week's annual surveys of R&D spending among the nation's largest firms. These data, which are broken down by sector on a somewhat different basis than the NSF data, show reported R&D spending in 1982 and percentage changes between 1981 and 1982. Among the industries with the largest growth rates during this period are computers, computer peripherals and services, oil service and supply, drugs, and telecommunications. Consistent with NSF's forecasts for 1984 are low growth rates for the automotive and non-computer machinery industries.

D. National Totals for R&D

Tables I-11 and I-12 give the best data available at this writing for total national expenditures for R&D, by source of funds and performer, respectively. More accurate

and detailed estimates and an updated source and performer matrix showing the overall national pattern of R&D, will be published by NSF later this spring.

The NSF data on which our Table I-11 is based indicate that in both 1983 and 1984 the federal government is funding about 46 percent and industry about 51 percent of total national expenditures for R&D, which are estimated at $88.2 billion in 1983 and $97.9 billion in 1984. These figures show federal government and industry support of R&D growing at about 11 percent in 1984. The increase in federal funding reflects the budgeted increases for national defense R&D. The 11.4 percent increase in industry support of R&D shown for 1984 is back at the 1982 rate after the recession-dampened 9 percent increase estimated by NSF for 1983, but still substantially below the 16 percent average annual increase the NSF statistics show for the 1978-1981 period. The amounts for R&D funding by colleges and universities are shown as increasing but barely keeping up with inflation.

Table I-12 indicates that expenditures for R&D performed by industry are estimated to increase by more than 12 percent in 1984, bringing the portion of the national R&D effort performed in industry to almost 75 percent. The figures also show a substantial increase in expenditures for R&D performed at colleges and universities: about 9 percent in current dollars and about 4.5 percent in constant dollars.

Tables

Table I-1. Composition of the FY 1985 Budget (outlays in billions).

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
CURRENT DOLLARS				
National Defense	$ 209.9	$ 237.5	$ 272.0	+14.5%
R&D included	(23.3)	(27.9)	(33.9)	+21.5%
Payments and grants[1]	450.6	465.9	492.7	+5.8%
Net interest	89.8	108.2	116.1	+7.3%
Undistributed offsetting receipts	-34.0	-34.0	-35.3	NA
Other government	79.6	76.1	79.9	+4.9%
R&D included	(14.5)	(16.2)	(16.4)	+1.3%
TOTAL OUTLAYS	$ 796.0	$ 853.8	$ 925.5	+8.4%
R&D included	(37.7)	(44.0)	(50.2)	+14.1%
CONSTANT FY 1972 DOLLARS				
National Defense	$ 85.9	$ 93.9	$ 102.8	+9.4%
R&D included	(9.5)	(11.0)	(12.7)	+15.9%
Payments and grants[1]	207.2	205.1	206.8	+0.8%
Net interest	41.2	47.7	48.8	+2.3%
Undistributed offsetting receipts	-15.0	-14.4	-14.2	NA
Other government	35.2	32.1	32.1	+0.2%
R&D included	(6.4)	(6.8)	(6.6)	-3.3%
TOTAL OUTLAYS	$ 354.5	$ 364.4	$ 376.2	+3.3%
R&D included	(15.9)	(17.8)	(19.3)	+8.6%

Source: OMB "1985 Budget Outlays in Constant Dollars, Second Edition," February 9, 1984, Tables 1 and 2; "OMB Data for Special Analysis K," FY 1985 Budget; and DOE agency budget justification.

[1] Payments to individuals and grants-in-aid.

Table I-2. FY 1987 and FY 1989 Projections In or Implied by the FY 1985 Budget (in billions).

CURRENT DOLLARS	FY 1985 Budget	FY 1987 Projected	FY 1989 Projected
Outlays:			
National Defense	$ 272.0	$ 348.6	$ 409.1
R&D included	(33.9)	(41.2)[1]	(43.3)[2]
Payments and grants	492.7	553.1	619.5
Net interest	116.1	130.9	126.3
Undistributed offsetting receipts	-35.3	-45.8	-52.0
Other government	79.9	81.6	80.9
R&D included	(16.4)	(18.2)[1]	(19.4)[3]
TOTAL OUTLAYS	$ 925.5	$1,068.3	$1,183.7
R&D included	(50.2)	(59.4)	(62.7)
Receipts	745.1	887.8	1,060.3
Deficit	180.4	180.5	123.4

[1]Derived from amounts shown in Part 5 of the FY 1985 budget and agency supporting projections plus AAAS estimates for the 15 percent of total R&D for which no official figures are available.

[2]AAAS projection based on trends in FY 1985 budget.

[3]AAAS projection based on NASA projections and assumed level budgets FY 1987-89 for other non-defense R&D.

Table I-2, continued.

	FY 1985 Budget	FY 1987 Projected	FY 1989 Projected
CONSTANT FY 1972 DOLLARS			
Outlays:			
National Defense	$ 102.8	$ 118.9	$ 127.7
R&D included	(12.7)	(14.0)	(13.4)
Payments and grants	206.8	212.9	221.3
Net interest	48.8	50.4	45.1
Undistributed offsetting receipts	-14.2	-16.9	-17.7
Other government	32.1	30.0	27.4
R&D included	(6.6)	(6.7)	(6.6)
TOTAL OUTLAYS	$ 376.2	$ 395.3	$ 403.9
R&D included	(19.3)	(20.7)	(20.0)

Source: OMB "1985 Budget Outlays in Constant Dollars, Second Edition," February 9, 1984, Tables 1 and 2; OMB "Data for Special Analysis K," 1985 Budget; NASA projections of FY 1985 Budget; and AAAS estimates consistent with the foregoing sources.

Table I-3. Defense and Non-defense R&D in the FY 1985 Budget
(budget authority in millions).

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
CURRENT DOLLARS				
Conduct of R&D:				
National defense	$24,931.3	$29,270.9	$36,966.4	+26.3%
Non-defense	13,828.4	15,097.2	15,707.0	+4.0%
Total, conduct	38,759.7	44,368.1	52,673.4	+18.7%
R&D Facilities:				
National defense	717.0	890.7	891.1	--
Non-defense	564.8	646.0	736.6	+14.0%
Total, facilities	1,281.8	1,536.7	1,627.7	+5.9%
Total R&D:				
National defense	25,648.3	30,161.6	37,857.5	+25.5%
Non-defense	14,393.2	15,743.2	16,443.6	+4.4%
Total R&D	40,041.5	45,904.8	54,301.1	+18.3%

Table I-3, continued.

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
CONSTANT FY 1972 DOLLARS				
Conduct of R&D:				
National defense	$10,147.0	$11,503.5	$13,862.4	+20.5%
Non-defense	6,112.2	6,371.0	6,329.9	-0.6%
Total	16,259.2	17,874.5	20,192.3	+13.0%
R&D Facilities:				
National defense	291.8	350.0	334.2	-4.5%
Non-defense	249.6	272.6	296.9	+8.9%
Total, facilities	541.4	622.6	631.1	+1.4%
Total R&D:				
National defense	10,438.8	11,853.5	14,196.6	+19.8%
Non-defense	6,361.8	6,643.6	6,626.8	-0.2%
Total R&D	$16,800.6	$18,497.1	$20,823.4	+12.6%

Source: OMB "Data for Special Analysis K," and agency budget justification. Conversion to constant dollars by authors using OMB fiscal year deflators for defense and non-defense R&D.

Table I-4. Total Federal Funding for R&D
(budget authority in billions).

	FY 1967[1] Actual	FY 1972[1] Actual	FY 1982 Actual	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget
Current dollars:						
Conduct of R&D						
Budget Authority	$ 16.5	$ 16.5	$ 37.6	$ 38.8	$ 44.4	$ 52.7
Obligations	16.5	16.5	37.8	38.4	45.2	51.7
Outlays	16.1	16.2	36.0	36.5	42.7	48.7
R&D Facilities						
Budget Authority	0.6	0.6	1.2	1.3	1.5	1.6
Obligations	0.6	0.6	1.2	1.2	1.6	1.6
Outlays	0.8	0.6	1.3	1.2	1.3	1.5
Total R&D						
Budget Authority	17.1	17.1	38.7	40.0	45.9	54.3
Obligations	17.1	17.1	39.0	39.6	46.7	53.3
Outlays	16.9	16.7	37.3	37.7	44.0	50.2
Constant FY 1972 dollars: (Budget Authority only)						
Conduct of R&D	23.2	16.5	16.5	16.3	17.9	20.2
R&D Facilities	0.8	0.6	0.5	0.5	0.6	0.6
Total R&D	$ 24.0	$ 17.1	$ 17.0	$ 16.8	$ 18.5	$ 20.8

Source: "OMB Data for Special Analysis K," as revised, and National Science Foundation, Federal Funds for Basic Research, Development and Other Scientific Activities, Vol. XXV. Conversion to constant dollars by authors based on OMB "1985 Budget Outlays in Constant Dollars," Second Edition, Feb. 9, 1984, Table 8.

[1]Authors' estimates based on above sources.

Table I-5. Major Components of Federal Funding for R&D*
(budget authority in billions).

	FY 1967 Actual	FY 1972 Actual	FY 1982 Actual	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget
Current dollars:						
Defense[1]	$ 8.8	$ 9.2	$ 22.9	$ 25.6	$ 30.2	$ 37.9
Non-defense[2]	8.3	7.9	15.8	14.4	15.7	16.4
Space[3]	4.7	2.7	3.6	1.7	1.9	2.3
Health[4]	1.3	2.0	4.1	4.5	5.1	5.2
Energy[5]	0.6	0.6	3.5	2.9	2.8	2.7
General Science[6]	0.5	0.7	1.5	1.6	1.9	2.2
All Other	1.2	1.9	3.1	3.7	4.0	4.0
Total R&D	17.1	17.1	38.7	40.0	45.9	54.3
Constant FY 1972 dollars:						
Defense[1]	12.4	9.2	9.8	10.4	11.9	14.2
Non-defense[2]	11.7	7.9	7.2	6.4	6.6	6.6
Space[3]	6.6	2.7	1.7	0.8	0.8	0.9
Health[4]	1.8	2.0	1.9	2.0	2.2	2.1
Energy[5]	0.8	0.6	1.6	1.3	1.2	1.1
General Science[6]	0.7	0.7	0.7	0.7	0.8	0.9
All Other	1.7	1.9	1.4	1.6	1.7	1.6
Total R&D	$ 24.0	$ 17.1	$ 17.0	$ 16.8	$ 18.5	$ 20.8

Table I-5, continued.

Source: Authors' estimates based on data from OMB and agency budget justifications. Conversion to constant FY 1972 dollars by authors based on OMB deflators.

*Includes conduct of R&D and R&D facilities.

[1]Includes DOD and defense activities of DOE.

[2]Includes all R&D not in Defense.

[3]NASA less space applications and aeronautical research.

[4]For FY 1982-1985, includes health research in HHS, VA, Education and EPA. FY 1967 and 1972 based on OMB data for health research in all federal agencies.

[5]Includes NRC, EPA energy research, and DOE less defense activities and general science.

[6]Includes NSF and DOE general science.

Table I-6. Conduct of R&D by Character of Work
(budget authority in billions).

	FY 1967[1] Actual	FY 1972[1] Actual	FY 1982 Actual	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget
Current dollars:						
Basic Research	$ 1.8	$ 2.2	$ 5.4	$ 6.2	$ 7.0	$ 7.6
Applied Research	2.9	3.6	7.4	8.3	8.5	8.6
Total Research	4.7	5.8	12.8	14.5	15.4	16.3
Development	11.8	10.7	24.7	24.2	28.9	36.4
Total conduct of R&D	16.5	16.5	37.6	38.8	44.4	52.7
Constant FY 1972 dollars:						
Basic Research	2.5	2.2	2.4	2.7	2.9	3.0
Applied Research	4.1	3.6	3.3	3.6	3.5	3.4
Total Research	6.6	5.8	5.6	6.3	6.4	6.4
Development	16.6	10.7	10.9	10.0	11.5	13.8
Total conduct of R&D	$ 23.2	$ 16.5	$ 16.5	$ 16.3	$ 17.9	$ 20.2

Source: "OMB Data for Special Analysis K," as revised, and National Science Foundation, Federal Funds. Conversion to constant dollars by authors based on OMB deflators.

[1]Authors' estimates based on above sources. Basic and applied research figures adjusted to reflect reclassification of DOD research for comparability with current figures.

Table I-7. Defense and Non-Defense R&D by Character of Work
(budget authority in billions).

	Current $			Constant FY 1972 $		
	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget
Basic Research						
Defense	$ 0.8	$ 0.8	$ 0.9	$ 0.3	$ 0.3	$ 0.4
Non-Defense	5.5	6.1	6.7	2.4	2.6	2.7
Total	6.2	7.0	7.6	2.7	2.9	3.0
Applied Research						
Defense	3.0	2.8	3.0	1.2	1.1	1.1
Non-Defense	5.3	5.6	5.6	2.3	2.4	2.3
Total	8.3	8.5	8.6	3.6	3.5	3.4
Development						
Defense	21.1	25.6	33.0	8.6	10.1	12.4
Non-Defense	3.1	3.3	3.4	1.4	1.4	1.4
Total	24.2	28.9	36.4	10.0	11.5	13.8
Conduct of R&D						
Defense	24.9	29.3	37.0	10.1	11.5	13.9
Non-Defense	13.8	15.1	15.7	6.1	6.4	6.3
Total	38.8	44.4	52.7	16.3	17.9	20.2

Table I-7, continued.

	Current $			Constant FY 1972 $		
	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget
R&D Facilities						
Defense	0.7	0.9	0.9	0.3	0.4	0.3
Non-Defense	0.6	0.6	0.7	0.2	0.3	0.3
Total	1.3	1.5	1.6	0.5	0.6	0.6
Total R&D						
Defense	25.6	30.2	37.9	10.4	11.9	14.2
Non-Defense	14.4	15.7	16.4	6.4	6.6	6.6
Total	$ 40.0	$ 45.9	$ 54.3	$ 16.8	$ 18.5	$ 20.8

Source: Authors' estimates based on "OMB Data for Special Analysis K," and agency budget justifications. Conversion to constant FY 1972 dollars by authors based on OMB deflators. Columns may not add due to rounding.

Table I-8. R&D in Selected Agencies[1]
(budget authority in millions)

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% change FY 1984-85 Current $	% change FY 1984-85 Constant $
DOD	$23,573	$27,876	$35,336	+26.8%	+20.9%
DOE - defense	1,975	2,286	2,522	+10.3%	+5.3%
(TOTAL Defense)	(25,648)	(30,162)	(37,858)	(+25.5%)	(+19.8%)
DOE - general science	568	639	745	+16.5%	+11.3%
DOE - energy	2,622	2,610	2,499	-4.3%	-8.5%
NASA	2,735	2,971	3,466	+16.7%	+11.4%
NSF	1,059	1,247	1,427	+14.4%	+9.2%
NIH	3,814	4,264	4,356	+2.2%	-2.4%
Other HHS	557	613	597	-2.7%	-7.0%
USDA	885	923	926	+0.4%	-4.1%
EPA	234	248	280	+12.7%	+7.6%
Education	102	111	107	-3.3%	-7.5%
NOAA	213	240	167	-30.4%	-33.5%
NBS	94	95	103	+8.2%	+3.5%
USGS	149	162	148	-8.6%	-12.7%
Bureau of Mines	97	87	69	-21.0%	-24.5%
All Other	1,265	1,533	1,555	+1.5%	-3.0%
(TOTAL Non-defense)	(14,393)	(15,743)	(16,444)	(+4.4%)	(-0.3%)
Total R&D	$40,042	$45,905	$54,301	+18.3%	+12.7%

Source: "OMB Data for Special Analysis K," as revised, and agency budget justifications.

[1]Includes conduct of R&D and R&D facilities.

Table I-9. Conduct of Basic Research by Agency in Current Dollars
(budget authority in millions).

	FY 1972[1] Actual	FY 1982 Actual	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85 Current $	% Change FY 1984-85 Constant $
HHS[2]	$ 626	$ 1,954	$ 2,475	$ 2,781	$ 2,913	+4.8%	+0.1%
(NIH)	(546)	(1,841)	(2,323)	(2,608)	(2,738)	(+5.0%)	(+0.3%)
NSF	368	913	993	1,172	1,330	+13.5%	+8.4%
Defense-Military[3]	328	696	787	840	930	+10.7%	+5.6%
Energy[4]	268	779	763	833	940	+12.7%	+7.4%
NASA	332	536	617	689	827	+20.0%	+14.6%
Agriculture	137	334	365	386	420	+8.8%	+3.9%
Interior[5]	--	74	95	106	97	-9.0%	-13.1%
Smithsonian[5]	--	56	54	60	66	+9.8%	+4.8%
Commerce[5]	--	17	19	20	18	-9.0%	-13.1%
VA[5]	--	13	14	15	15	-1.3%	-5.8%
Education	--	16	13	11	14	+29.1%	+23.3%
EPA	--	24	21	23	25	+11.0%	+6.0%
AID[6]	--	--	10	10	9	-6.0%	-10.2%
Other	138	31	17	20	19	-7.8%	-12.0%
Total, Basic Research Current Dollars	$ 2,197	$ 5,440	$ 6,243	$ 6,967	$ 7,623	+9.4%	--
(Constant FY 1972 Dollars)	($ 2,197)	($2,394)	($2,732)	($2,916)	($3,046)	--	+4.5%

Source: "OMB Data for Special Analysis K," as revised, and National Science Foundation, Federal Funds for Research, Development and Other Scientific Activities, Vols. XXV and XXVII. Conversion to constant dollars by authors based on OMB deflators.

[1]Columns may not add due to rounding; percentages calculated on unrounded numbers.

[2]Authors' estimates based on above sources. NIH estimate comparable with current R&D classification.

[3]Includes Education for FY 1972.

[3]Includes DOD budget category "6.1"; FY 1985 also includes $30 million from advanced technology development category. Source for FY 1972: DOD.

[4]Reported under Atomic Energy Commission for FY 1972.

[5]Reported under "other" for FY1972.

[6]Reported under "other" prior to FY 1983.

Table I-10. Estimated Support for Conduct of R&D at Colleges and Universities in Current Dollars (budget authority in millions).

	FY 1982 Actual	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 84-85 Current $	% Change FY 84-85 Constant $
HHS	$ 2,220	$ 2,451	$ 2,751	$ 2,820	+2.5%	-2.1%
(NIH)	(2,065)	(2,274)	(2,542)	(2,614)	(+2.8%)	(-1.8%)
NSF	711	787	931	1,068	+14.7%	+9.5%
Defense-Military	716	778	894	996	+11.5%	+6.4%
Agriculture	255	277	279	299	+7.4%	+2.5%
DOE	253	303	321	343	+6.8%	+1.8%
NASA	186	189	210	235	+11.9%	+6.9%
AID	48	52	54	45	-16.2%	-20.0%
EPA	51	36	43	41	-3.3%	-7.6%
Education	65	57	62	59	-6.1%	-10.3%
Interior	31	29	22	15	-32.7%	-35.8%
Transportation	18	22	19	20	+4.1%	-0.6%
Commerce	38	59	72	33	-55.0%	-57.0%
Other	19	16	16	14	-9.7%	-13.7%
Total Current dollars	$ 4,609	$ 5,057	$ 5,673	$ 5,987	+5.5%	--
(Constant FY 1972 dollars)	(2,028)	(2,208)	(2,286)	(2,299)	--	(+0.6%)

Source: "OMB Data for Special Analysis K," as revised. Conversion to constant FY 1972 dollars by authors based on OMB deflators.

Columns may not add due to rounding; percentages calculated on unrounded numbers.

Table I-11. National Funds for R&D by Source of Funds[1] (in millions).

	1975 Actual	1980 Actual	1983 Est.	1984 Est.	% Change 1983-84
CURRENT DOLLARS					
Federal Government	$18,109	$29,451	$40,303	$44,720	+11.0%
Industry	15,820	30,920	45,260	50,425	+11.4%
Colleges and Universities	749	1,314	1,615	1,700	+5.2%
Non-profit institutions	535	933	975	1,050	+7.6%
Total	35,213	62,618	88,153	97,895	+11.1%
CONSTANT 1972 DOLLARS[2]					
Federal Government	$14,537	$16,545	$18,615	$19,725	+6.0%
Industry	12,589	17,329	20,971	22,389	+6.8%
Colleges and Universities	599	738	747	752	+0.7%
Non-profit institutions	428	524	451	465	+3.1%
Total	28,153	35,136	40,784	43,329	+6.2%
Total GNP[3]	1,549.2	2,631.7	3,309.5	3,642.0	+10.1%
Total R&D, percent of GNP	2.27%	2.38%	2.66%	2.69%	+1.1%

Source: NSF estimates for Science and Technology, Data Book, October 1983, p. 6; and author's estimates based on NSF Science Resource Studies Highlights, July 22, 1983 (NSF 83-316). GNP data from Economic Report of the President and the FY 1985 Budget.

[1] Amounts represent current R&D operating costs based on data from performers of R&D and therefore do not correspond to the figures for R&D in the budget elsewhere in this report. Capital expenditures for R&D are generally excluded.

[2] Based on GNP implicit price deflator.

[3] In billions.

Table I-12. National Funds for R&D by Performer of R&D[1] (in millions).

	1975 Actual	1980 Actual	1983 Est.	1984 Est.	% Change 1983-84
CURRENT DOLLARS					
Federal Government	$ 5,354	$ 7,632	$10,228	$10,970	+7.3%
Industry	24,187	44,505	65,000	73,000	+12.3%
Colleges and Universities	3,409	6,060	7,675	8,375	+9.1%
Other performers	2,263	4,421	5,250	5,550	+5.7%
Total	35,213	62,618	88,153	97,895	+11.1%
CONSTANT 1972 DOLLARS[2]					
Federal Government	$ 4,344	$ 4,297	$ 4,697	$ 4,827	+2.8%
Industry	19,229	24,944	30,139	32,365	+7.4%
Colleges and Universities	2,766	3,412	3,525	3,685	+4.5%
Other performers	1,814	2,483	2,423	2,452	+1.2%
Total	$28,153	$35,136	$40,784	$43,329	+6.2%

Source: NSF estimates for Science and Technology, Data Book, October 1983, p. 7.

[1]Amounts represent current R&D operating costs based on data from performers of R&D and therefore do not correspond to the figures for R&D in the budget elsewhere in this report. Capital expenditures for R&D are generally excluded.

[2]Based on GNP implicit price deflator.

Table I-13. Industry Spending for R&D by Business Week Groupings, 1982[1] (in millions).

Industry	1982	% Change from 1981
Aerospace	$2,518.1	+7.5%
Appliances	159.4	+19.1%
Automotive		
cars, trucks	4,527.4	+0.3%
parts, equipment	367.2	+4.6%
Building Materials	164.6	+4.3%
Chemicals	3,032.0	+16.2%
Conglomerates	1,429.0	+7.2%
Containers	102.2	-15.6%
Drugs	2,978.0	+18.7%
Electrical	1,501.7	+2.9%
Electronics	1,364.5	+15.1%
Food and Beverage	669.0	+16.3%
Fuel	2,357.3	+6.2%
Information Processing		
computers	4,716.9	+22.7%
office equipment	769.5	+8.5%
peripherals, services	453.8	+33.4%
Instruments: measuring devices, controls	718.5	+14.3%
Leisure Time	1,024.7	+14.9%
Machinery		
farm, construction	781.6	+3.1%
machine tools, industrial, mining	416.5	+3.0%
Metals and Mining	230.5	0.0
Miscellaneous Manufacturing	1,269.9	+9.1%
Oil Service and Supply	815.0	+24.2%
Paper	273.2	+6.5%
Personal and Home Care Products	711.1	+16.9%
Semiconductors	562.5	+12.8%
Steel	192.1	+10.1%
Telecommunications	1,090.5	+21.7%
Textiles, Apparel	54.9	+16.7%
Tires, Rubber	493.5	+9.4%
Tobacco	18.8	-9.7%
Total	$35,763.7	+11.5%

Source: "The U.S. Still Leads the World in R&D Spending" (Business Week, 20 June 1983; © by Mc-Graw-Hill, Inc.).

[1]Based on SEC data for the 776 companies that reported 1982 sales of $35 million or more and R&D expenses amounting to at least $1 million or at least 1 percent of sales.

Part II: Agency R&D Budgets

Introduction

In this section, R&D in the federal budget is examined from the perspective of the agencies that support and perform the work. First, separate chapters examine the R&D activities of the principal R&D agencies. Then, we present a summary table of R&D budget totals by agency from FY 1982 to FY 1985, followed by detailed statistical tables to support discussions of the Reagan Administration's programs and policies for R&D.

The discussions of agency R&D programs assess budget trends and policy choices reflected in the FY 1985 budget in as detailed a manner as possible. Some agencies have been treated in greater depth than others, reflecting differences in availability of information or issues of special importance. Aspects of certain important agency R&D budgets which do not appear in this section may be found in the disciplinary analyses in Part III. For instance, although there is no chapter devoted to NOAA in this section, a detailed discussion of its programs is contained in Chapter 14, "FY 1985 R&D in the Atmospheric and Oceanic Sciences."

Budget figures in the detailed agency tables may not correspond exactly to the amounts in the summary tables here and elsewhere in the report. The data in the summary tables were generally prepared based on OMB and NSF data, while the agency tables were derived using agency budget justifications. R&D is often not managed or budgeted by the agencies in categories which correspond exactly to those used by OMB and NSF for statistical purposes. Where significant differences have been found, they are discussed in footnotes to the agency tables.

Where trends in constant dollars are shown, our calculations are based on the deflators developed by OMB which are consistent with the administration's economic assumptions that OMB considers applicable to R&D. These deflators have been refined to reflect differences in rates of inflation in defense and non-defense R&D costs.

Agency Summary

The composition by agency of the totals for conduct of R&D and R&D facilities is shown in Table II-1. The numbers, with the exception of the figures for DOE and NASA, are drawn directly from the budget authority data compiled by OMB for "Special Analysis K" of the FY 1985 budget. (The DOE figures reflect revisions to the agencys' calculations of amounts for R&D following preparation of the "Special Analysis," and the NASA figures include AAAS estimates of facilities costs.)

The last column of the table shows the percentage change in constant dollars from FY 1984 to 1985 -- "real" dollar figures, intended to reflect trends in the purchasing power of agency R&D allocations. These figures highlight several agency trends discussed in detail in the sections which follow: constant dollar increases for conduct of R&D for the Department of Defense (+21.7 percent), NASA (+10.4 percent), NSF (+8.6 percent), and EPA (+7.6 percent); and constant dollar decreases for conduct of R&D in many other agencies, including DOE (-3.2 percent), HHS (-2.7 percent), and USDA (-1.2 percent).

Chapter 3

R&D in the FY 1985 Department of Defense Budget

American Association for the Advancement of Science
Willis H. Shapley

R&D for military functions of the Department of Defense (DOD) continues to be the largest and fastest growing element of R&D in the federal budget. It also continues to be the most impenetrable to analysis -- the overwhelming number of projects, mostly identified only by cryptic titles or unknown acronyms, the large gaps for security reasons, and the unavailability of narrative justifications frustrate detailed assessments by outsiders. Each year, the total size of the DOD budget and a few big ticket items are subjected to national debate and decision, but review and analysis of the details is a private game, played only by insiders in DOD, OMB, and on Congressional committee staffs.

It is probably true also, however, that the DOD FY 1985 R&D budget as submitted by the administration is not worth analyzing in much detail. Both Republican and Democratic leaders in Congress warned the administration in advance that further increases in the DOD budget of the magnitude proposed would not be approved by Congress. While the President has tried to exclude defense budget cuts from the bipartisan negotiations with Congress on reducing the deficit, it seems clear at this writing that Congress will again this year scale back substantially the rate of increase proposed in the budget. There is no reason to believe that R&D will be able to escape a substantial cut. As a budget category where the proposed rate of increase (26.8 percent) is well above the average (18.1 percent), it is an obvious target.

Table II-2 summarizes the R&D funding proposed in the FY 1985 budget. Continued increases somewhat above the anticipated inflation rate of almost 5 percent are proposed in the research and exploratory development categories. There is a tremendous 46.8 percent increase in advanced technology development, which is apparently at least in part related to the President's "star wars" initiative to try to find new

methods of defense against ballistic missiles. The 11.4 percent increase in strategic programs R&D is a slowdown after the 34.6 percent increase in FY 1984 when the MX program made its big jump to higher levels of funding. The annual increases in R&D on tactical programs and intelligence and communications programs are proposed to continue at unabated high rates. An unexplained feature of OMB's data on R&D in the FY 1985 budget is the large increase in funding support for R&D carried in appropriations other than the regular R&D accounts.

Table II-3 shows the organizational breakdown of the DOD appropriations for R&D. As indicated, this year the Navy is in for the biggest boost of the three military departments. By far the largest increase of all is in money proposed to be appropriated to the Secretary of Defense. This evidently includes the "star wars" increase in advanced technology development. By including this amount in the "Defense Agencies" appropriation, the Department has the flexibility to transfer it for conduct of the work to the Defense Advanced Research Projects Agency (DARPA) or any of the military departments, or any new organization that might be set up.

Table II-4 shows the portions of the DOD R&D budget classified as basic research, applied research, and development. Details of the amounts for basic research are shown in Tables II-5 through II-10. These details may have more validity than those for the rest of the DOD R&D budget because only relatively small increases are proposed and the Department has made special efforts in recent years to "protect" basic research.

Finally, Table II-11 shows the interesting point that with all the emphasis on increasing the DOD budget it was only in FY 1984 that obligations for DOD R&D first exceeded their FY 1965 level in constant dollar terms. For DOD basic research, the recent increases have only brought the level up to about 65 percent of the FY 1965 level in constant dollar terms.

Chapter 4

National Science Foundation FY 1985

Association of American Universities
John C. Crowley

Highlights

- Total budget request: $1,501.8 million, an increase of $179.8 million (13.6 percent) over FY 1984, an increase of 37 percent over FY 1983.

- Research and related activities: $1,308.2 million, a 14.6 percent increase with special emphasis on mathematical and physical sciences, engineering and biology.

- Research instrumentation support: increase 21.8 percent to $237 million, with $122 million provided through individual research projects and the remainder allocated to multi-user centers at universities (physics, materials, engineering, computer research, observatories and regional instrumentation centers) and national centers. The request provides a two-year increase of 96.5 percent.

- New $10 million program for new "modes" of engineering support -- centers for cross-disciplinary research in engineering, targeted on long term, high risk research important to industry and designed to train undergraduate and graduate students.

- Science and engineering education: $75.7 million, a slight increase, with $54.7 million for precollege science and mathematics education. During this year, FY 1984, the Foundation also will spend $13.9 million carried over as an unobligated balance from FY 1983.

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- Graduate student support:

  Fellowships: 1550 total awards, 550 new awards, increase stipend $900 to $9,000; the cost-of-education payments to institutions remain fixed at $4,900; total graduate fellows program is $21.0 million.

  Graduate research assistants: increase of $13.9 million (15.5 percent) will provide for a total of 11,614 students, 1050 more than in FY 1984.

- Postdoctoral researchers: $57.7 million, an increase of 11.6 percent will support 3500 postdocs, up by about 200 awards.

- The second group of 200 Presidential Young Investigators Awards is planned, bringing the total number supported to 400; 1000 are planned in FY 1988.

- Increase support for research at predominately undergraduate institutions (those awarding 20 or fewer Ph.D's in the sciences over the past two years) by $5.6 million to $42.4 million.

- An increase from $6 million to $20 million to improve access to advanced computer systems for researchers in all disciplines, plus NCAR will acquire a Class VII Advanced Vector Computer to assist researchers in the atmospheric and ocean sciences.

- Begin construction on the Very Long Baseline Array (VLBA) radio telescope.

- International science: an increase of $5.6 million to $90.2 million; $3 million of the increase is targeted on disciplinary activities with the research directorates now actively involved as a result of the recent reorganization and management plan.

Overview

The FY 1985 budget request for NSF sustains the administration's commitment to substantial expansion of investment in those university research and advanced education programs supported by the Foundation. The budget emphasizes the essential role which NSF continues to play in supporting

basic research. In FY 1983 NSF research obligations accounted for 16 percent of total federal support for basic research. NSF also provided 24 percent of total federal support for basic research to universities and colleges.

The Foundation plays almost a unique role in the support of certain fields. For example, the Foundation provides over 90 percent of support for university research in pure mathematics and anthropology and over 75 percent of total support for work in the earth and ocean sciences. NSF provides about one-third of total federal support in other fields, such as chemistry and electrical engineering, that also are supported by other agencies.

The FY 1985 budget request continues the administration's commitment to strengthening almost all of the Foundation's basic science programs. All of the so-called "hard sciences" receive increases significantly above inflation; engineering is the most favored area with overall increases of 22 percent requested. It is important to note, however, that an exception continues to be made for the social and behavioral sciences. Despite increases of almost 14 percent in current dollars, the social and economic sciences have not recovered significantly from the severe cuts imposed four years ago. Measured in constant dollars funding for these fields remains almost 50 percent below FY 1980 levels. Information Science and Technology programs also have not shared in the push for real growth now benefitting most other fields.

The criteria used by the Foundation in developing program priorities for FY 1985 parallel closely those of other recent budgets. They include: "the scientific excellence and promise of the activity; the need to sustain scientific momentum in certain key areas; maintenance of a broad base of support across a wide variety of science and engineering disciplines including provision of advanced equipment and facilities; the potential of an activity to contribute to important national goals; and the need to improve education and training for future scientists and engineers."

The Congress will consider the budget request in the context of several major organizational and management changes recently accomplished. Among the most significant of these is the elimination of the Office of Planning and Resources Management, the creation of a Controller's Office and a decision to vest the research directorates with broader responsibilities and a wider span of programmatic activities.

R&D Facilities, Equipment and Instrumentation:

Last year the FY 1984 budget announced substantial increases in obligations for research equipment and instrumentation; producing a two-year increase of 100 percent between FY 1982 and FY 1984. The emphasis on equipment will continue as the Foundation seeks to strengthen funding through individual project grants, through university-based centers and specialized facilities and through national research centers. In FY 1985 the Foundation is requesting $237 million for these purposes; this represents a 96.5 percent increase over FY 1983 and about a 20 percent increase over last year. (See the table on NSF funding for facilities, equipment and instrumentation within this chapter.) Half of the funds ($122 million) will support individual project proposals, with the rest targeted on special university-based centers, including the new centers for cross-disciplinary research in engineering, and national facilities. The FY 1984 budget reported that equipment manufacturers were interested in granting substantial discounts to NSF-funded researchers. The FY 1985 budget omits mention of this initiative.

In total the budget proposes $135 million for university-based facilities and centers, or a total increase of $27 million across physics ($52 million), engineering ($42.2 million), engineering ($13.4 million -- includes $10 million for the new engineering centers), computer research ($16.7 million), university observatories ($6 million), and regional instrumentation facilities ($4.7 million). Funding for National Centers and Facilities totals $178.5 million and includes: Astronomy Centers ($64.5 million), NCAR ($45.9 million), Upper Atmospheric Facilities ($4.1 million), Oceanographic Facilities ($36.4 million) and the Ocean Drilling Program ($27.6 million). When the $122 million for Research Project Instrumentation is added the budget estimates a grand total for centers and instrumentation of $435.5 million.

Mathematical and Physical Sciences:

$416.7 million +16.1 percent

The MPS budget continues to grow at a pace significantly ahead of inflation. Measured in constant dollars this directorate has received a 33 percent increase during the

Table 1. National Science Foundation R&D Facilities, Equipment and Instrumentation (obligations in millions).

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1983-85	% Change FY 1984-85
Mathematical and Physical Sciences	$ 59.6	$ 82.2	$ 99.0	+66.1%	+20.4%
Engineering	8.7	18.2	24.0	+175.9%	+31.9%
Biological, Behavioral, and Social Sciences	16.5	24.6	28.4	+72.1%	+15.4%
Astronomical, Atmospheric, Earth and Ocean Sciences	25.1	49.4	59.1	+135.5%	+19.6%
U.S. Antarctic Program	8.7	20.2	23.9	+174.9%	+18.3%
Scientific, Technological and International Affairs	2.0	2.4	2.6	+25.8%	+8.3%
TOTAL, NSF	$120.6	$197.0	$237.0	+96.5%	+20.3%

Source: National Science Foundation.

last five years, FY 1980-FY 1985. Mathematical Sciences are up 21.7 percent; Computer Research, Physics, Chemistry and Materials Research each increase by between 15 percent and 16 percent. Project support is increased to $265.3 million, or an increase of 13.1 percent. Special emphasis is given to strengthening support for and participation by graduate and postdoctoral students, to instrumentation and computing capabilities, the chemistry of life processes and the training of future materials scientists. Also included in the budgets of most programs is support for the acquisition of instruments to be used by research groups or departments. Across MPS a total of $24.3 million, or an increase of 19.1 percent, is provided for such special equipment. An 18.5 percent increase is requested for experimental computer research facilities, several nuclear physics laboratories and the Materials Research Laboratories. $10.3 million is budgeted for advanced scientific computing, including the establishment of university supercomputer facilities and networks.

Engineering:

$147.1 million +21.9 percent

The programs of the Engineering Directorate continue to grow at a catch-up pace. This year's request for a 22 percent increase continues the policy of the past several years, resulting in a constant dollar increase over the last five years of 39.2 percent. In FY 1980 the total investment in engineering research was $76.6 million. Among the major programs percentage increases are in a range from 17.8 percent in Civil and Environmental Engineering to 24.2 percent for Electrical, Computer, and Systems Engineering. A major initiative is the $10 million program to establish university centers for cross-disciplinary research focused on problems of importance to industry. These centers also will concentrate on education graduate and undergraduate students in engineering practice.

As the budget proposals for engineering are considered, Congressional authorizing committees also will weigh legislative proposals to amend the NSF Organic Act in ways that would substantially upgrade the place of engineering in the Foundation, to include renaming the Foundation as the National Science and Engineering Foundation and renaming and reorganizing the National Science Board. Such proposals are being opposed by several higher education groups and others.

Astronomical, Atmospheric, Earth, and Ocean Sciences:

$373.5 million +13.1 percent

The programs of the AAEO Directorate also are slated for increases designed to provide for growth above inflation. The AAEO budget is up overall by 13.1 percent, with increases from 8.1 percent for the Arctic Research Program to 19.4 percent for the Astronomical Sciences. During the past five years the AAEO budget has increased in constant dollars by 24.2 percent, with both the Earth and Ocean Sciences receiving real increases of 36 percent over the period.

Biological, Behavioral, and Social Sciences:

$253.1 million +12.6 percent

All of the programs of the BBS Directorate receive increases greater than an inflationary adjustment. These increases are in a range from 8.2 percent for Information Science and Technology to 14.0 percent for Physiology, Cellular and Molecular Biology.

When examined in constant dollars for the past five years, quite another picture emerges. The Biology, Biotic Systems and Resources programs have grown by more than 17 percent since FY 1980.

Despite recent increases, however, the Social and Economic Sciences remain at a level nearly 50 percent below the FY 1980 level, measured in constant dollars. Clearly these programs have not recovered from the severe cuts imposed by the administration's first budget. This undoubtedly will generate continuing pressure from these fields for restorations to former levels either by add-ons or by congressionally mandated reallocations from the more favored disciplines. The Behavioral and Neural Sciences also remain almost 3 percent below the FY 1980 level in real terms, and the Information Science and Technology program is more than 14 percent below the FY 1980 level.

U.S. Antarctic Program:

$115.1 million +12.4 percent

A total increase of $12.6 million is requested. Of this

sum $0.8 million is for research awards, thus bringing the total research support to $11 million. The rest of the increase will pay $6 million for DOD military retirement costs shifted from DOD and $5.8 million for increased operations support costs.

Scientific, Technological, and International Affairs:

$46.9 million +15.0 percent

A total increase of $6.1 million is requested. Virtually all of this amount, or $5.8 million, is being provided in order to comply with the mandated percentage required by P.L. 97-219, the Small Business Innovation Development Act of 1982. The NSF budget applies the entire $5.8 million to its Small Business Innovation Research (SBIR) program. The funds will continue 30 Phase II awards begun last year; increase from $35,000 to $40,000 the size of the 110 Phase I awards and award about 40 new Phase II projects. There are no other changes or funding improvements for any of the remaining Industrial Science and Technological Innovation (ISTI) programs that involve industry/university cooperative research projects, research centers or productivity improvement research.

International Cooperative Scientific Activities are funded jointly by STIA and by the research programs of the directorates. Together $13.8 million is budgeted for International Science and Technology Initiative. STIA also continues to coordinate several Foundation-wide programs that are funded partially or in whole by the research directorates. These include the Presidential Young Investigators Research Awards and the Support for Predominately Undergraduate Institutions Programs. The Experimental Program to Stimulate Competitive Research, mandated by the Congress a few years ago, is discontinued as planned.

Science and Engineering Education:

$75.7 million -14.8 percent

A carryover of $13.9 million from FY 1983 to FY 1984 creates the impression of almost a 15 percent decrease. In fact funding for Precollege Science and Mathematics Education is funded at slightly above the original FY 1984 plan, $75 million. An increase of $0.7 million is requested for Graduate Research Fellowships, as noted above.

Again this year, the education budget omits any investment in undergraduate science, mathematics, or technology programs, a continuing cause of concern among both undergraduate colleges and research-intensive institutions. The absence of any investment in undergraduate programs may again lead congressional committees to seek a reallocation of funds from certain research programs into initiatives for these areas.

Chapter 5

Health Research (HHS) in the FY 1985 Budget

National Association of State Universities and Land-Grant Colleges
Jerold Roschwalb

Introduction:

The title of this chapter is primarily a carryover from the earlier years of this publication. In the 1970's, documents were readily available depicting health research budgets in more than a dozen federal agencies. Some of them were substantial, such as those in the Veterans Administration or in the Department of Defense laboratories such as the Walter Reed Army Institute of Research. Others were relatively small but reflected the pervasiveness of health research throughout the federal government.

It is likely that a similar distribution of research activity continues to take place in many agencies but documents out of OMB or other sources are not available (in part due to doubts over the accuracy of the data and its non-compatability). This chapter, therefore, will devote its attention to the two major agencies involved in biomedical research: the National Institutes of Health (NIH), and the Alcohol, Drug Abuse and Mental Health Administration (ADAMHA). This reflects no meaningful change in the chapter, since even when more detail was available on the activities elsewhere in the government, the vast preponderance of our medical research was taking place in these two agencies.

Readers of this chapter in previous editions of this publication will recall that the text devotes itself to two or, occasionally, three categories of reporting. The first, and most significant, is straight reporting of the numbers and explanations for the numbers presented by the Administration to the Congress. The second seeks to provide background explanation for major changes and indicates trends and various forms of significance. It also cites the commentary of agency and Congressional staff on what the

numbers mean and how they will be dealt with in the realities of administering these major programs. The third element takes into account the probable relationships between the numbers submitted for the budget and Congressional behavior and indulges itself somewhat in a cross between gossip and editorial. This has been restricted appropriately to a minimum and will be so again.

Background Observations:

Scientists conducting experiments over a period of time that reveal a regular pattern might justifiably draw a conclusion that the next experiment will follow the same pattern. Scientists concerned with NIH funding would be pleased if the same principle could be applied to the appropriation process. What we mean by this is that for the past several years, particularly the most recent two, we have witnessed the Administration sending forward a budget request for NIH and ADAMHA that was wholly unsatisfactory in terms of increasing funding to even meet inflationary needs. The Congress considered the proposal and its alternatives and chose to vote more than $300 million additional for FY'83. Last year, after the president requested only $72 million over FY'83, the Congress voted more than $400 million in addition. For FY'85 we have a budget request that seeks $89 million over last year. However, into the experiment there have entered new realities. One of them, the great annual budget deficit, may turn out to be a catalyst that causes major changes in the scientific process while it remains relatively unchanged itself.

A very senior member of the House Appropriations Subcommittee responsible for health appropriations is reported to have stated his belief that vast increases for research are in order. That is most welcome news. What he and his colleagues on the subcommittee will do when faced with the responsibility of putting numbers into a regular appropriation bill - or into a continuing resolution - may turn out to be quite different from the value laden statement of the Member.

NIH staff, reviewing the budget proposals for association representatives, have noted that it "has no handles." By this they mean to stress that, except for the total amount requested, the budget request does not have a multitude of points of antagonism to be attacked by the community. There are no major discrepancies in the amounts for the different institutes that cannot be explained and to, therefore, cause hostility. The indirect costs cuts proposals of the past two

years are basically removed for the moment. There is an aura of evenhandedness in the treatment of most of the mechanisms in the budget. But the issue of the amount is present and will form the fundamental line of battle between the scientific community and the Administration in contending for the attention of the Congress in this unusual appropriations year.

The President's Budget

The charts in this text for NIH and ADAMHA depict clearly the specific requests for each of the institutes and other program areas of the two agencies. These raw numbers show in the "Summary by Appropriation for NIH" that NIH, as a whole, has an increase over FY84 of 2 percent. The various institutes have increases ranging from a high of 3.6 percent for the Allergy Institute to a low of 1.8 percent for the Child Health Institute, but the divergence from the average is very small.

NIH publishes charts that are a "Summary by Activity." In these charts each institute is broken down between 5 and 8 subcategories. They are no more interesting then the major charts. They do show some details of interest, such as a drop in Cancer Center Support of $965,000.00, and an increase of $2.5 million in that same Institute's Research Manpower Development Program. In a total budget request of $1.1 billion the figures do not stand out. In institutes and their programs, the same can be said for the various other institutes and their programs both reductions and increases are comparatively small in the context of the total amounts requested, and do not reveal any major shift in institute or agency philosophy or strategy.

Of possible interest is that in all of the subcategories for the different institutes and programs listed, only two remain precisely the same in the FY '85 request as they were in the FY'84 appropriation and they are in the Division of Research Resources Biomedical Research Support and Minority Biomedical Research Support remain the same.

A chart that is of interest is the "Summary by Mechanism." This shows that, in research projects, non-competing projects will grow by 164 to a total of 12,094, believed to be the second highest total for such projects in NIH's history. (This is a significant line item because it reflects changes in appropriations in earlier years.)

Increasing the number of competing grants above 5000 in the past two years (389 in '83, 272 in '84) means that in the next two years these additions are carried forward into the non competing area where they must be funded. Because of this basic "out year mathematics," strong supporters of funding for NIH caution other proponents to add up the consequences down the road, so that we do not encounter a situation in which the obligation to continue funding non-competing projects makes it difficult to maintain reasonable funding levels for competing project. In competing projects, the Administration calls for 5,000 grants although it had passed that mark two previous year. This almost certainly will raise the ire of the scientific societies and others. It will justify the arguments of years back when NIH declared 5000 grants as a floor, a minimum, that in a short time it would be distorted into a ceiling, a maximum.

In Research Centers there is a 1 percent cut in the Specialized/Comprehensive Centers and similar increases in the General Clinical Research Centers, Biotechnology Research Grants and the Lab Animal Science and Primate Program - a small cut overall, and on the surface, no significant change. In the other Research Grant areas, the one significant change is in Clinical Education Programs, in which Biomedical Research Support is unchanged and there are small increases in some of the other programs.

The training area has a significant change in that the total number of trainees requested for FY '85 is 9,000, down 863 from FY '84 and down 1,570 from FY '83. The bulk of the 863 cut comes in institution awards (796) but there are cuts in individual awards too (67).

Intramural research pretty much holds the line gaining $9 million in a $546 million budget.

In ADAMHA, the gross numbers also reveal no extraordinary changes though there are some important ones particularly in the area of training at NIMH. In Mental Health, the research totals show a drop of less then $4 million in the FY '85 request after a substantial increase of $22 million dollars last year. But training is cut by more than half from $36 to $15 million. Drug abuse, on the other hand, calls for an increase of $9 million to a total of $63.5 million, and training remains the same. Alcoholism also increases substantially from $42.9 to $47.8 million, with training remaining the same. In short, Mental Health is affected quite adversely by the budget request even in research, while the other two institutes fair comparatively well.

Information and Interpretations

The numbers presented on official budget charts are accurate and even the text that accompanies them when they are sent to Capitol Hill cannot be faulted for accuracy. However, the truth may not always be the whole truth, and internal political circumstances can result in information being held back. The budget documents tell us that for all research project grants there will be a 5 percent increase in the average cost permitted. This seems to say that the relatively low current inflation will be taken care of by this increase and that competing as well as non-competing grants will be fully funded. However, it appears to Congressional staff that for most institutes the expected peer review recommendation will be higher than that amount. It may well be that the Administration is leaning on a history that shows the institutes can make cuts in the budgets of grants without losing any of them. There is no record of grants being returned because of cuts.

Hill staff and others believe that the result of these calculations will be about a 6-7 percent cut in direct costs in the new and competing award category, measured against the levels for awards recommended by study sections. A similar is expected in the non-competing research project grant category, though the cuts there might be 1 or 2 percent smaller. In new and competing grants, the cuts for FY'83 and FY'84 were 9.2 and 3.4. In the non-competing category, the cuts for those two years were 3.2 and 1.3. In short, the anticipated cuts will exceed all in the past two years except for the new and competing in '83.

There is a question of how these cuts are made up once they are received by the principal investigator. The plasticity of projects is a key. The mere passage of time from the application to the announcement of the award very often results in very new projects being conducted with new boundaries set by the actual award. The livelier the area of science, the more likely that by the time of the award there will be a whole new array of investigative activity contemplated, trimmed or adapted to the available funds.

At the university or institute where a NIH funded project is being conducted the reduction of 5 percent or 7 percent in the grant multiplied by each of dozens or more grants can have unsettling effects. It appears that computer time is one of the prime areas that investigators reduce in their

budget plans when forced to accomodate to a lower NIH ceiling. But the computer time is not a throwaway, since it is imperative for the conduct of the research.

The result is importuning of the department head or dean or vice president at the campus or institute for time on computers controlled by the central administration. This does not come free. It means that another pocket is paying for a portion of the NIH grant. The same thing is true for another area often dropped from the budget plan, the laboratory assistant. Here, too, the assistance required for the conduct of the work is drawn from a general pool and charged to the organization rather than to the NIH.

In recent years, the various institutes have used this approach to increase the numbers of awards they could make. In fact, under the plan for FY'85 the institutes would have a certain degree of leeway, and some would cut the average proposal by more than other institutes because of a determination that increased numbers of grants have to be awarded disciplines they are supporting.

This technique of funding is not believed to be able to be capable of standing up for too long. Since none of the parties, the NIH, the university, the research institute, the investigators are operating from large savings accounts.

This problem is somewhat related to the one involving facilities and instrumentation. Studies conducted in recent years dealing with all scientific equipment at research intensive universities have shown that the typical instrument in a university laboratory is twice as old as similar instrumentation in the private industry. In the past two years, efforts have started in several agencies dealing with science research to increase the funds available for instruments, sometimes in the form of seperate awards, other times in the form of increased support in grants with the extra sum designated for instrumentation.

This has been the case in NIH and ADAMHA, but to a very small degree and reports from academic and other officials responsible for university and biomedical research consider the situation critical. The facilities situation is equally bad and, perhaps worse, as almost no funds are flowing from the federal government for much needed renovation and repair, let alone new structures. At a time of stringent budgeting, priorities usually are set that seek to maintain the research enterprise and look to physical property and machinery, as it were, as expenditures that can be delayed. But scientists

are reporting that the conduct of science itself is seriously hampered by the absence of modern equipment or by the lack of proper space needed to carry on the increasingly sophisticated projects typical of contemporary biomedical research. A cut in the direct costs awarded by NIH for each grant thus becomes one more drain on institutions already pondering how to maintain the enterprise. (Inadvertance is the major descriptor in this process. For example, it is hardly likely that there is a single person involved in administering Medicare and Medicaid who wishes to weaken the biomedical research activity of this country. However, the fiscal complexity of most academic health centers ties together education and training, health care offered to patients at the university hospital and research conducted at the center. Plans for trimming or restraining increases in the costs of the large federally sponsored health care programs could - inadvertantly, of course - reduce available funds to the health centers and undermine the conduct of research.)

NIH officials do correctly note that in the Division of Research Resources areas like biotechnology are slated for increases in funding while the Shared Instrumentation program stays even, but it did not even exist two years ago. While there is a real investment in instrumentation at NIH the amount of funds allocated is a very small fraction of the documented need.

A salient problem noted in the budget request involves the recommendation for cutting 588 personnel slots at NIH. While a number of these slots will be cut through attrition and reduction in the summer program, the preponderant number probably would come out of the Intramural Program. The reason is that Extramural Program administration operates in accordance with the Civil Service regulations. These make selective removal of permanent staff relatively difficult.

However, in the Intramural Program, a system has evolved in which large numbers of "staff fellows" can spend up to seven years at NIH becoming deeply involved in major research but not invested with tenure. After that seven year period, they undergo a special review by the scientific directors of the institutes and may receive a permanant appointment.

If NIH wishes to avoid a reduction in force, it is likely to turn to the more vulnerable staff members in the intramural program, accelerating the flow of young people and failing to retain its best people. A one year cutback would

cause mischief and damage but enable the enterprise to operate. Two or three years of comparable cuts might permanantly cripple the Intramural Program.

One other major concern of many NIH officials is the implication of priorities in recent years. Discussions of how to achieve the most for the money in biomedical research almost always conclude in agreement that the best vehicle for important new finding in research are the projects conducted by individual scientists. Making this a priority and favoring it works well when ample funds are available for other mechanisms as well. However, if the projects are considered of sufficient significance to have a certain minimum amount of funds set aside for them, and the amount of funds remaining is too small, other mechanisms, and the progress in biomedical research that they bring, suffer.

Although it may be an abberation of one year, the budget proposal for FY'85 calls for only one clinical trial. Last year, the number of clinical trials initiated by seven institutes was 19. If a clinical trial is the important mechanism for taking laboratory findings to the bedside to determine accuracy of new vaccines, drugs, surgical and other techniques, then a sharp reduction in their number would replicate a problem frequently of concern in the physical sciences of not taking new knowledge from the laboratory shelf to the marketplace.

Budget documents show that research project grants for FY'85 will be funded at $2.49 billion. This would be a 4.3 percent increase over FY'84 or $103 million. In research training, however, the budget calls for $164 million. This includes a much needed increase in the stipend for trainees of 5 percent, but, as noted earlier, it provides for only 9,000 research trainees, a reduction of 863 from '84 and 1,570 from '83.

There is debate over what the proper numbers of research trainees should be and concern that perhaps a wrong standard is used in determining the trainees by basing it in part on academic positions assumed to be available in the future. Others, however, view with special concern the sharp reduction in the numbers of M.D.'s going into research. There is a strong belief that notwithstanding the quality of Ph.D. research scientists, a lack of clinical experience and the absent perceptions of the physician in the research process could have a seriously negative effect on what research is done and the ultimate quality it may have.

Funding for other research mechanisms for FY'85 (centers, contracts, etc.) drops by $8 million, or less than 1 percent from last year. While not an enormous cut, it does reflect the concern discussed above.

The running controversy over intramural versus extramural support will not be given fuel by the Administration s budget, since the increase for Intramural research is less than $10 million and less than 2 percent over FY'84. Coupled with the potential impact on intramural research of the reduction of nearly 600 positions in NIH, intramural research cannot be looked at this year as a favored element in the NIH structure.

Assessments and the Identified Issues

Documents prepared by NIH display the distribution of RO-1 grants. Ithe percentage of new principal investigators among all RO-1 awardees hit a peak of 15.5 percent in 1974. The figure in 1970, when the chart begins, is 8.4 percent. Between then and 1981 there are some dips and rises, but they all exceed that first year's figure except for 1982, the last year on the chart, when the percentage of new principal investigators is 8.3 percent. If the figures for FY'83 and '84 continue a trend, then there is a serious problem of underfunding the talent of the coming generation.

A second chart displays the distribution for competing RO-1 grants where, in 1970, the new principal investigators numbered 27.4 percent. The figure rose to a high of 34.3 percent in 1974 and kept fairly close to that mark but began dipping in 1980 (29.8 percent) and '81 (26.8 percent) and hit a low of 22.9 percent in 1982.

In a third chart, showing "success of new applicants on research project applications - type 1 - RO-1," the same pattern is revealed. The chart begins in 1970 with 34.2 percent new applicants awarded. It rises to a high in 1975 of 55.1 percent, has small changes after that until it comes to 1982 where the figure is 31.5 percent.

In a fourth chart, "successive other applicants, not first time ever on type 1 - RO-1 research project applicationsk," we again see the chart beginning with 27.5 percent, rising to 46.1 percent and plummeting to 25 percent in 1982.

In a matter already referred to, the ratio of M.D.'s to Ph.D.'s on all types of RO-1 grants, the chart runs from '68 to '82 and shows a similar display. Starting with a high of 35.3 percent in 1968, it inches downward almost every year until it comes to 1982 with a figure of 22.3 percent. The current year and most recent year before that being unavailable, it would be an error to jump to a conclusion, except to say that real concerns are founded in hard statistics and draw attention to the future of biomedical research in this country.

As was the case in the past two fiscal years, the biomedical research community has organized itself into an Ad Hoc committee that will petition the Congress for better funding than requested by the Administration. The essential arguments of the Ad Hoc group reflect the concerns of the community with the NIH budget. Some points may be highlighted.

Much discussion in the community deals with "paylines" and percentages of awards (paylines at NIH and ADAMHA are "high" in reverse order, i.e., the lower the score, the more valued the proposal.) It is the contention of the scientific leadership in the biomedical research community that a score of up to 300 is very good research; at 250 we are dealing with excellence; at 200 we are dealing with high excellence.

The average payline now is about 175. If we were to settle merely for superb research and keep the awards to scores under 200 we would have to increase the award rate from the current 32 percent to approximately 43 percent and still fail to fund a remarkable amount of fine research.

(As noted earlier, this would increase the awards at NIH by about 1,000, all of which would have to be funded in the next few years as well as the first year of the award, creating a cumulative total of awards and cumulative requirement of appropriations. That would make complete good research sense, but might not be politically feasable.)

For ADAMHA, the situation is slightly different, but fundamentally the same. The rate of awards currently is about 37 percent and the leaders in the research fields supported by ADAMHA feel that it should rise to a 43 percent rate in the new and competing area. In ADAMHA too, it is believed that the number of investigators supported under the research scientist program should be increased by some 20 percent. While the numbers are smaller than NIH, NIMH also is slated for serious cuts in positions - 29 in all - and these would occur in the intramural program.

In the training area, to make the program whole, the ADAMHA leadership in the field believes that approximately 1,300 trainees paid higher stipends are needed in both the pre and post-doctoral programs. The President's budget calls for 982 trainees. The 1,300 may appear to be a large increase but it is only half the approximately 26 trainees supported 15 years ago.

It may be argued that comparisons among agencies prove nothing, but they nevertheless are interesting. The two percent increase for NIH as a whole and the six percent increase for ADAMHA research and research training pale beside the increases in many other agencies that are in the 13, 14 and 15 percent area. Last year, Administration officials in response to such questions of - why not a similar increase in biomedical research? - responded that given available funds, and given the determination by the Administration to move the physical sciences forward, and given the comparatively sound funding for the health sciences in previous years, the budget request was a logical result.

The final argument does not ring true to people in biomedical research, since those budgets have not been sound in terms of real increases, but only appear to be so because of the large numbers of dollars involved. At NIH a single percent involves $45 million, compared to, say, NSF, where a single percent is one-third that size. The community argument, therefore, will be that there should be some parity in the treatment of the different scientific disciplines. The physical sciences certainly must be increased as proposed by the Administration and so should biomedical research.

Of interest will be the manner in which Congress will respond to the modish elements in science. Alzeimer's disease is slated for a substantial increase in NIH. Also, the President's science advisor made reference to "biotechnology" a few times in his press briefing on the budget this year.

Define it how you will, biotechnology has been a reality in the nation's agricultural research laboratories for a century and has been very much an activity in biomedical research laboratories for some time. However, it now is acknowledged as significant and recognized for its potential not only to deal with the diseases that plague humankind, but also because it has extraordinary commercial possibilities that could favorably affect the nation's economy, its foreign trade, balance of payments and ultimately, even those heralded deficits.

The argument has been made for some time for science research generally and biomedical research in particular that the federal government was not for spending dollars in the same ways as it did for example, when it paid hospital bills in Medicare. Rather, it was making a unique investment. There are sound economic studies that document a return of about $13 for every dollar invested in biomedical research. The figures may be different for the physical sciences, but are equally good.

Further, it does not take too much imagination to project the results over a decade in research in all of the scientific disciplines to realize that our defense establishment, at least its most sophisticated weapons systems are profoundly dependent upon what occurs in the nation's laboratories.

It does not seem to stretch deductive logic at all to say that a nation, whatever Administration may be in office, needs to recognize that if its greatest responsibilities are indeed the national defense and the maintaining of an orderly economy, should be force feeding its scientists with funds to enable scientific progress to move apace. That this has not occurred testifies to a number of things, many not quite understood, including the capacity for scientists and educators to educate the public and its elected leadership.

We may well have a test of this argument in the first half of 1985. There are reports that the House leadership is determined to have all appropriation bills considered at the end of May and early June and all appropriation business - even if it is one large Continuing Resolution covering the entire budget - completed by early July.

The summer is an almost lost cause for legislation in any case, since the two conventions and related political business will take Congress away from Washington for most of the time. October is already known to be slated for recess because of the election. The leadership may think that nothing good can come out of the political atmosphere of September so that they may call for adjournment in mid-year.

In early March of 1984, as we go to press, there is serious talk in budget committees and elsewhere of possible "freezes." Freezes may be absolute, covering all programs. Most likely, they would have thaws in them permitting some additional funds for defense and other exempted programs. Whether biomedical research can prevail once again on the Congress, whether it be in a freeze situation or in a more

normal appropriation situation, to continue funding NIH and ADAMHA at least at levels to permit reasonable activity should be known fairly shortly.

Alcohol, Drug Abuse
and Mental Health Administration
(in thousands)

	1983	1984 Est.	1985 Est.
1. General Mental Health			
(a) Research	$159,000	$181,329	$177,603
(b) Training	35,953	36,072	15,360
2. Drug Abuse			
(a) Research	$ 47,587	$ 54,654	$ 53,513
(b) Training	891	891	891
3. Alcoholism			
(a) Research	$ 33,027	$ 42,866	$ 47,835
(b) Training	1,086	1,086	1,086

Chapter 6

R&D in the Department of Energy

American Association for the Advancement of Science
Jill H. Pace

INTRODUCTION

The Reagan Administration's energy policy has consistently emphasized nuclear R&D programs while calling for substantial reductions in programs for fossil, solar, environmental and conservation R&D. This approach has met with resistance from Congress, which has refused twice to act on proposals to dismantle the Department, and has substantially restored funding to many DOE programs which were proposed for cutbacks or termination.

The DOE budget request for FY 1985 to show that the administration has softened its approach considerably. While most of the stated policies appear to be unchanged, the proposed program cuts are nowhere near as substantial as they have been in previous budgets. In accordance with Administration R&D policy DOE continues to stress longer-term research as opposed to development and demonstration projects. However, while DOE's R&D budget would increase by 4 percent over FY 1984, the total -- $5,771.8 million -- still remains 8 percent below the FY 1981 level of $6,211.4 million, and non-defense DOE R&D, $3,249.9 million in FY 1985, is 29 percent below the $4,551.7 million approved in FY 1981. Details of the DOE budget are displayed in Table II-17.

I. ENERGY SUPPLY R&D

Solar and Other Renewables

The FY 1985 budget includes $163.6 million for solar energy R&D programs, about 10 percent less than appropriated

in FY 1984. Previous budgets have proposed significantly larger cuts in these programs, but many of these cuts have been rejected by Congress. Still, the cumulative effect of the Reagan Administration's approach to this area is substantial: solar R&D programs, under this budget, would be cut by 70 percent from their FY 1981 levels.

All areas of solar R&D would be cut, with the exception of solar technology transfer activities. Some of the largest percentage cuts would occur in the building energy systems program (down 27.8 percent, to $11.9 million), where decreases are planned for heat transfer systems analysis and materials and component development; the thermal energy systems program (down 14.5 percent to $37.5 million), where support would drop for central receiver R&D, distributed receiver R&D and planning and assessment activities; and ocean energy systems (down 36.4 percent, to $3.5 million), cut in the areas of thermodynamics research and experimental verification.

Both the solar and the geothermal energy programs emphasize planned increases in technology transfer activities in FY 1985. This effort translates to an increase of 84.6 percent above FY 1984 for solar technology transfer programs (to $6.0 million) and an order-of-magnitude increase (to $1 million) for geothermal technology transfer. Other geothermal program activities planned for FY 1985 include analyses of long duration geopressured resource flow test data, and final construction of the Fenton Hill, N.M., Hot Dry Rock (HDR) thermal loop. Completion of this project will fulfill a DOE agreement with Japan and West Germany for work in this area under the International Energy Agency agreement.

The administration began phasing out the hydropower program in FY 1982; for FY 1985 it plans a minimal level of activity ($0.5 million, down 37.5 percent from FY 1984), which would provide only management guidance to previously-funded efforts, and continue some technology transfer activities.

Nuclear Energy

DOE's nuclear energy program includes activities related to conventional reactor systems, waste disposal technologies, breeder reactor systems, reactor safety studies,

and space power systems. These programs are slated for a 16.1 percent reduction in support from FY 1984 -- 32 percent below FY 1983 -- to $523.9 million in FY 1985. This overall reduction in DOE's nuclear energy programs is primarily the result of termination of the Clinch River Breeder Reactor (CRBR) project.

The CRBR has been, of course, the major element of DOE's breeder reactor program. However, after eleven years, the project was finally killed by Congress at the end of October 1983. The parties involved in the project -- DOE, the Tennessee Valley Authority (TVA); Commonwealth Edison, Project Management Corporation, and Breeder Reactor Corporation -- formally agreed to details of termination in December 1983.

Termination, however, does not mean an end to the project's claim on DOE's budget -- estimates of close-out costs range from $150 to $350 million and up. An appropriation transfer of $40.0 million from the Uranium Enrichment program was made in the FY 1984 budget as an interim measure to fund some of the immediate termination activities; the source of the remainder of the funds has yet to be determined.

Despite the demise of CRBR, DOE's breeder reactor program would receive $308.1 million under the FY 1985 budget. According to the Department, the restructured breeder program will focus on "major substantive international collaboration," and on "resolving the technological and economic uncertainties which are a prerequisite for the private sector to demonstrate and deploy the breeder." The revised program will not include a new federally-funded demonstration project.

In the convertor reactor program, the high temperature reactor, proposed for elimination in last year's budget, would receive a 15.4 percent increase, to $34.6 million. Taking into account Congressional sentiments, DOE now considers the program necessary "to support the concept of small, inherently safe, high temperature gas-cooled reactors as well as providing for evaluation of the potential this concept could have for applications in domestic and international markets."

The Civilian Radioactive Waste R&D program consolidates various new and ongoing nuclear waste management and

disposal programs. The program is planned for a level of $27.7 million in FY 1985. Most of the increase above the FY 1984 level of $14.2 million would be in the areas of spent fuel storage R&D, emphasizing at-reactor storage technologies; and alternative disposal concepts research, examining the feasibility of disposing of nuclear waste in stable geologic formations of the deep ocean floor.

The advanced nuclear systems program would remain about level with FY 1984, at $33.5 million. This program is responsible for developing both isotope and fission energy sources for civilian and military applications. FY 1985 activities are intended to support development of several different radioisotope thermoelectric generators for the NASA Galileo and International Solar Polar Missions, for future NASA missions, and for DOD.

Magnetic Fusion

According to DOE, "the proper role of the Federal Government in fusion is to demonstrate scientific and engineering feasibility." Accordingly, DOE's Magnetic Fusion Energy program is viewed as a three-phase effort in "developing the technical data base required for the private sector to determine the commercial potential of fusion." The two major magnetic confinement concepts being pursued as part of this base program are closed magnetic toroidal systems (particularly tokamaks) and open magnetic mirror systems.

Funding for the magnetic fusion program would increase from $470.8 million in FY 1984 to $483.1 million in FY 1985, and is intended to support the transition between the program's first two phases. The first phase, achieving near-term scientific feasibility (determining that a magnetically confined high temperature plasma can be used to produce as much energy as is used to heat the plasma) will be considered complete when the Tokamak Fusion Test Reactor (TFTR) at Princeton achieves energy breakeven, planned for late 1986. The second program phase is for "product definition," in this case, identifying an appropriate reactor core plasma confinement concept which can become the plasma core for an advanced engineering device and serve as the focus of the next stage of research. A first step in this phase would be to experiment with ignited plasmas and long pulses. The third phase of the program is planned to

eventually concentrate on product development, leading to construction of commercial fusion power reactors.

In addition to this core of activities, support will also be provided for concept improvement activities in other, less well-developed areas of magnetic fusion research. An increase of $3.1 million is provided for the National Magnetic Fusion Energy Computer Network, which provides access to supercomputer capability for the entire magnetic fusion program. The increase will primarily fund the lease of a Class VII computer, needed for design of the tandem mirrors and stellarators.

Basic Energy Sciences

The Basic Energy Sciences (BES) program is slated for a sizeable increase in FY 1985, up 24.4 percent over FY 1984 to $419.5 million. This reflects a 48.5 percent increase above the FY 1983 level.

The largest percentage increase goes to the applied mathematical sciences subprogram, up 90.2 percent over FY 1984, to $29.8 million. The increase will expand basic research in scientific computing at national laboratories, universities and private research institutions, and will establish experimental computing capabilities to explore new areas of large-scale scientific computing. The increase would also allow greater access to state-of-the-art supercomputers for scientists involved in Office of Energy Research programs. A related supercomputer effort is being proposed by NSF.

The materials science subprogram would receive an increase of $34.4 million, to $188.7 million in FY 1985. In addition to the core materials science program, the request includes $41.4 million for the Advanced Materials Research initiative -- $9.4 million for operating expenses, $2.2 million for capital equipment, and $29.9 million for construction. This area has been the subject of considerable debate during the past year, since the FY 1984 budget first proposed the materials initiative, highlighting a National Center for Advanced Materials (NCAM) at Lawrence Berkeley Laboratory (LBL).

The NCAM proposal appeared in the FY 1984 budget request without benefit of review by the scientific community. It

ran into Congressional opposition on that score, and funding for the center was reduced in congressional action. At the same time, however, Congress used the funds cut from NCAM to add support for construction of a Vitreous State Laboratory at Catholic University in Washington, D.C. and a National Center for Chemical Research at Columbia University in New York, neither of which had been subject to peer review or included in the budget request. Congress ultimately directed that, prior to the obligation of funds for any of the three projects, each should undergo technical review and approval. According to DOE, an ad hoc panel was established in April 1983 to review the proposed NCAM, but the other projects have not yet been formally proposed to DOE and therefore have not yet been reviewed. The result is that the FY 1985 budget request does not include funds for either the Catholic or the Columbia University projects, but does include $10.8 million for construction of two NCAM facilities (a Surface Science and Catalysis Laboratory and an Advanced Materials Laboratory). Commensurate with this reduction in scope and the existence of many other materials laboratories, DOE has dropped the "N" from NCAM. In addition, $12.6 million is earmarked for "programmatic research and R&D associated with construction" for CAM, and for the Stanford Synchrotron Radiation Laboratory and the National Synchrotron Light Source at Brookhaven.

The 19 percent increase in chemical sciences will support operation of Sandia Laboratories' Combustion Research Facility, operating several state-of-the-art lasers, and the National Synchrotron Light Source. Support will continue to be emphasized for programs in such areas as photochemistry, combustion thermodynamics, and catalysis. In the biological energy research area, a 19 percent increase is planned for research in the applications of biotechnology to energy development. Specific areas of interest include investigations on microbial interactions in bioconversion, and on molecular and cellular aspects of stress in plants. Interdisciplinary research activities, such as studies on interactions of roots and soil, are also proposed. The nuclear sciences subprogram includes modest research support related to construction of an Ion Collision Physics Facility at Kansas State University. The university is providing funds for the facility, which will house the superconducting booster accelerator and a charged source to be added to an existing tandem Van de Graaff generator. Increased support for facilities operations throughout the BES program reflects a concern of the Energy Research

Advisory Board's laboratory study that these expensive specialized facilities are underutilized.

University Research Instrumentation

DOE's University Research Instrumentation program is part of an interagency effort which includes similar programs at DOD and NSF. The program began in FY 1984, at a congressionally-approved level of $4.0 million, which is proposed to increase to $6.0 million in FY 1985. support will be provided, on a competitive basis, to 10-15 university groups to purchase state-of-the-art instrumentation for advanced energy-related research. The instruments to be purchased cost several hundred thousand dollars apiece, and include items such as plasma emission spectrometers, scanning microscopes, and hydrothermal equipment.

University Research Support and Energy Research Analysis

This subprogram area is scheduled to rise from $7.5 million in FY 1984 to $11.2 million in FY 1985. This will provide for a 50 percent increase in faculty and student training opportunities at the national laboratories, including institutes and workshops for high school science and math teachers. This increase is responsive to studies by the White House Science Council (WHSC) and the Energy Research Advisory Board (ERAB) that urged enhanced interaction between universities and national laboratories. Funds are also provided for university reactor fuel assistance, for technology assessments and for technical support to ERAB.

Multiprogram General Purpose Facilities

This activity, down to $39 million from $42.1 million in FY 1984, continues the DOE commitment to refurbish national laboratory facilities that have no specific program sponsor. This effort is consistent with concerns raised by the WHSC and ERAB about the overall health of the DOE laboratories. The budget for the DOE multiprogram national laboratories is displayed in Table II-18.

II. FOSSIL ENERGY R&D

Fossil energy R&D programs overall would be cut by 17 percent from FY 1984, to $272.8 million. This represents a decrease of 73 percent from the FY 1981 level of $991.5 million. The coal program comprises more than 80 percent of the fossil energy effort. It would be cut by about 19 percent in FY 1985. However, the coal program includes some $7 million for new acid rain related research, focused on control technology. Increases are also provided for startup and operation of the TVA fluidized bed combustion demonstration facility, and underground coal gasification technology development. Programs slated for decreases include fuel cell R&D, magnetohydrodynamics and coal liquefaction activities.

Petroleum programs would receive a modest increase of 4.4 percent, to $37.9 million in FY 1985. Increases would go to advanced exploratory research programs, specifically, increasing the number of microbial enhanced oil recovery field tests and supporting more fundamental petroleum chemistry and advanced environmental and technology research; to arctic and offshore research on ice characterization, permafrost and seafloor stability and soils properties; and to enhanced oil recovery activities related to heavy and light oil and tar sands. Oil shale research would be reduced. Gas programs are proposed for a 40 percent reduction, to $10.1 million. This would include reductions in all unconventional gas recovery activities except those related to methane hydrates.

III. ENERGY CONSERVATION

The FY 1985 budget would increase the various conservation R&D activities by about 7 percent. The plan includes some initiatives common to all four areas: increased technology transfer activities, new fellowship programs for university and industry scientists to conduct conservation-related research at the national laboratories and increased funding for some capital equipment acquisitions. Highlights of the various programs include:

- Buildings and community systems. The FY 1985 level of $35.3 million, 5.6 percent below FY 1984, includes cuts

in research related to envelope systems, wall and roof systems and insulation materials, and increases for indoor air quality control research, building energy retrofit research, and appliance standards activities.

- Industrial energy conservation. The $33.3 million requested for this program, essentially level with FY 1984, would support equipment acquisitions (e.g., fiber optics and spectrographic equipment for molten metal analysis, infra-red radiation monitoring equipment and coal water slurry fuel measurement equipment). Activities will be reduced in the areas of industrial process efficiency and industrial cogeneration.

- Transportation energy conservation. The budget request of $51.1 million includes $17.6 million for advanced materials development, most of which will go to complete construction of a new High Temperature Materials Laboratory at the Oak Ridge National Laboratory. Support is also provided for research and technology in structural ceramic materials for use with automotive gas turbines, and for electric and hybrid vehicle R&D.

- Multisector. Multisector R&D activities would receive a substantial increase, to $26.5 million. Activities benefitting from this include catalysts and biocatalysts research, materials science research, combustion and thermal sciences research, tribology, and the inventors' program.

IV. GENERAL SCIENCE AND RESEARCH

The General Science and Research program is composed of the High Energy Physics program and the Nuclear Physics program. An overall increase of $105.5 million (16.5 percent) is proposed for these areas in FY 1985.

High Energy Physics. The $561 million budget for high energy physics will support overall use of present accelerator facilities at about 55 percent of their capacity, slightly above the FY 1984 level. (DOE estimates the maximum use rate of the accelerators to be about 80 percent of capacity, due to planned maintenance and necessary downtime between experiments.)

Construction of the Stanford Linear Accelerator Center (SLAC) Linear Collider began in FY 1984, and would continue at a level of $60.5 million in FY 1985, up $26.3 million. Funds are also provided for completion of the construction at Fermilab of the Tevatron II proton-accelerator and continued work on the Tevatron I proton-antiproton colliding beam projects.

The high energy physics program also includes preliminary R&D for a Superconducting Super Collider (SSC), envisioned as a proton-proton collider. The SSC concept was put forward by the High Energy Physics Advisory Panel as the appropriate next machine rather than the now-abandoned Isabelle. Early efforts will investigate various superconducting magnet designs and design criteria for the facility.

Nuclear Physics. The FY 1985 budget request would support the Nuclear Physics program at $183.6 million, up 15.5 percent from FY 1984. This level would maintain the overall use of the national nuclear physics accelerator facilities at about 90 percent of their FY 1984 level, since most of the increase will support construction.

The major new effort planned for FY 1985 is initiation of construction of a Continuous Electron Beam Accelerator Facility (CEBAF) project with the Southeastern Universities Research Association (SURA) at Newport News, Virginia. The project is one result of the long-range planning for basic nuclear research undertaken jointly by the DOE/NSF Nuclear Science Advisory Committee (NSAC). At various times, NSAC and others had recommended construction of a high-energy continuous electron beam facility; by January 1983 five such proposals had been submitted, and NSAC set up an ad hoc "Panel on Electron Accelerator Facilities" to review and evaluate them. The panel recommended acceptance of the SURA proposal, which involved construction of a new National Electron Accelerator Laboratory, presently known as CEBAF since there are other electron accelerator laboratories. The facility will include an electron linear accelerator/stretcher ring complex capable of delivering intense, continuous beams in the energy range from 500 to 4,000 MeV.

The FY 1985 budget request also provides for completion of the university accelerator upgrades at the University of Washington and Yale University, and for completion of

construction of the Tandem/AGS Heavy Ion Transfer Line project at Brookhaven (which began in FY 1984 with funds reprogrammed from the Isabelle project in the high energy physics program).

Two smaller projects, the Argonne Tandem/Linear Accelerator System (ATLAS) and a new injector at the Stanford Linear Accelerator Center, are also scheduled to be completed and begin operation in FY 1985.

V. ATOMIC ENERGY DEFENSE ACTIVITIES

DOE's Atomic Energy Defense Activities are organized into seven program areas which include support for development and testing of nuclear weapons, development of technologies for monitoring nuclear weapons treaties, and R&D related to safeguarding nuclear materials and storing and disposing of nuclear wastes. These national defense R&D activities are proposed at a level of $2,521.9 million in FY 1985, up 10 percent over FY 1984.

- Weapons activities. The request of $1,510.8 million, up 19 percent over FY 1984, will support "efforts to explore the President's strategic defense initiative within the nuclear weapons technology base," according to DOE. The request will also initiate the Nuclear Weapons Research, Development and Testing Facility Revitalization project at a level of $91.5 million, and will continue development efforts on warheads for the Peacekeeper system, the Trident II, and the Advanced Air-to-Surface Missile System.

- Inertial confinement fusion. This program supports weapons design technology, and is also intended to explore the long-range possibility of using inertial fusion as an energy source. FY 1985 funding of $138.0 million, $31.7 million below FY 1984, includes final funding for construction of the Particle Beam Fusion Accelerator II at Sandia National Laboratory, and support to begin experimental programs on the NOVA glass laser facility at the Lawrence Livermore National Laboratory. Support is also included to complete experiments on the Antares carbon dioxide laser at Los Alamos. The administration has been scaling back this program, since inertial confinement fusion is no longer viewed as a serious short-term energy source. Basic research is planned to continue to explore its long-term potential.

• Naval reactors development. Funding for R&D in this area increases slightly, from $423.0 million in FY 1984 to $456.9 million in FY 1985. Much of the increase is for development of advanced reactors to improve the capability of nuclear powered naval warships.

• Verification and control technology. This program would increase by 20 percent in FY 1985, to $25.7 million. This would provide for increased space detection activities for treaty verification and monitoring, and increased technical analyses to support DOE's arms control policy development activities.

• Defense waste management. Waste management R&D and technology efforts would drop about 16 percent below FY 1984, to $184.8 million, for various activities related to the handling and disposal of radioactive wastes and byproducts generated by nuclear materials production and naval propulsion. The decrease is primarily in construction activities. Phased construction of the Waste Isolation Pilot Plant (WIPP) in New Mexico is planned to proceed on schedule, although at a reduced level of funding. The plant is intended to provide an R&D facility to demonstrate safe disposal of defense transuranic waste, and for conducting R&D on other high-level wastes.

• Security and safeguards. This program is responsible for developing means of protecting DOE's nuclear weapons, materials, facilities and classified information from theft and sabotage. It is proposed for a level of $58.7 million in FY 1985, an 18.6 percent increase from FY 1984.

• Materials production. R&D in this area would increase by 11.4 percent, to $147.0 million in FY 1985. This would include a decrease in support for the special isotope separation R&D program, and increases for reactor operating and processing activities, and for tritium production R&D.

Chapter 7

NASA in the FY 1985 Budget

American Institute of Aeronautics and Astronautics
Robert Riebling (Johan Benson, coordinator)

Highlights

- The NASA budget request of $7,491 million is up $273.7 million, or 3.8 percent over the current 1984 estimate. Once again, this implies no growth, or even some decline, after projected inflation. Administrator Beggs says, "Though modest in growth, this budget is bold in spirit and far-sighted in vision."

- Within this overall NASA budget, R&D is estimated at $3,466 million, up 16.7 percent over FY 1984. Table II-19 summarizes the NASA budget and provides estimates of R&D, R&D support costs, and all other NASA (non-R&D shuttle operations).

- The centerpiece of the FY 1985 budget is a $150 million program initiative to begin development of a space station. However, there is still no mention of a fifth Orbiter.

- Three of the four new starts introduced last year (i.e., a Shuttle-tethered Satellite, a Venus Radar Mapper, and the Numerical Aerodynamic Simulation Project) continue to be nurtured, but the Advanced Communications Technology Satellite (ACTS) has been descoped to an experimental ground test program.

- A $16 million new start for a Mars Geoscience/Climatology Orbiter is another indicator of the slow renaissance of planetary exploration.

- The budget has been restructured to sharpen the line of demarcation between R&D and operations. Space Transportation Capability Development (R&D) has been separated from last year's Space Transportation Programs category, and

Tracking and Data Advanced Systems (R&D) has been split off from the previous Tracking and Data Acquisition line item. Operational activities from these two earlier categories have been regrouped under the new Space Flight, Control and Data Communications banner, and represent nearly one-half of the budget request.

- NASA total manpower still remains at a 21-year low, but demographics are improving slightly as new hires continue to replace older workers.

Space Station

A major program initiative in the FY 1985 budget is $150 million to begin development of a space station. This represents an increase of $136 million over the funding for precursor activities which was book-kept under several other line items in FY 1984. The cost of the space station through the early 1990s is estimated to be approximately $8 billion.

The intent is to establish a permanent human presence in space, building on the operational capabilities of the Space Shuttle. The space station is to be a multipurpose facility to be used for research and technology development, commercial manufacture of pharmaceuticals and critical materials, space structures, and research to extend man's stay-time in space. A modular design philosophy will permit it to evolve through time. It will be Shuttle-launched and assembled in low-earth orbit. International participation in its development and use will be invited.

Planned FY 1985 Space Station Program

	$K
Systems Definition/Integration	58,300
Focused Technology	34,200
Utilization Requirements	14,100
Supporting Studies & Program Support	12,200
Flight Experiments	11,000
Advanced Development	20,200
TOTAL	150,000

Space Transportation Capability Development

Although mainline Shuttle development has been completed and the operational phase is under way, NASA is still working on improving performance capability, enhancing the reliability of systems, completing production of the fleet and procuring necessary space parts. Accordingly, this line item includes R&D funding for:

- The second and third Spacelab missions.

- The launch of the second and third Tracking and Data Relay Satellites.

- Completion of the Shuttle fleet with delivery of the fourth orbiter, Atlantis (OV-104), planned for December 1984, and continuing acquisition of structural spares to support the fleet.

- Continued support for a joint program with DOD to modify the Centaur as an upper stage for the Space Transportation System.

- Improvements to the Space Shuttle propulsion system with emphasis on Main Engine mission life and Solid Rocket Booster performance.

- Continued hardware development for the U.S./Italian Tethered Satellite System to conduct experiments in regions of space remote from the Shuttle Orbiter.

Excluding the space station program, funding for this line item is down some $64.3 million, or 15 percent, from last year.

Space Science and Applications

The combined budget for these activities (which include physics and astronomy, planetary exploration, life sciences, solid observations, environmental observations, other space applications and technology utilization) for FY 1985 increased by a healthy $237.5 million, or nearly 21 percent, after a more modest increase last year.

- Physics and Astronomy grew by $109.6 million, or 19 percent, to $677.2 million. Continued development of the

Space Telescope, the Gamma Ray Observatory and Spacelab payloads accounts for nearly two-thirds of the requested budget in this area.

Explorer development has leveled off.

- The Planetary Exploration program appears to be enjoying something of a comeback after several very bleak years. Requested funding is up nearly $70 million, or 32 percent, in FY 1985. The Mars Geoscience/Climatology Orbiter is in as a new start for $16 million, aimed at a 1990 launch. It is being billed as the first in a new series of relatively low-cost planetary observers to investigate scientific questions of more limited scope. Venus Radar Mapper funding leaped 219 percent to $92.5 million, as subsystem fabrication and mission software development began, heading toward a 1988 launch. Galileo and International Solar Polar Mission development continue toward a planned 1986 Shuttle/Centaur launch.

- The Solid Earth Observations program FY 1985 budget reduction of 16 percent reflects the zeroing out of Landsat-4, which was handed over to NOAA last year.

- Environmental Observations grew 36 percent to $220.7 million. This growth is attributable almost entirely to the start of design and development of the Upper Atmosphere Research Satellite and its instruments, and of the scatterometer for the Navy Remote Ocean Sensing System.

- The Advanced Communications Technology Satellite (ACTS) program, introduced with much fanfare as a new initiative last year, has been restructured to encompass only an experimental ground test program, and no contract will be awarded for a flight program.

Aeronautical Research and Technology

The budget increased by $40.1 million (13.3 percent), to $342.4 million. Within this, the R&T base increased a modest 8 percent to $233.3 million. The significant enhancement of research in the fundamental aeronautical disciplines, which we saw in last year's budget, appears to have leveled off again, although the National Transonic Facility at Langley Research Center will become fully operational in 1985.

The Systems Technology Programs increased 26 percent to $109.1 million, reversing the past two years' trend of stop-

ping all such programs not relevant to national defense. Subsonic aircraft systems technology grew by nearly a factor of four, and Numerical Aerodynamic Simulation (NAS), termed by Administrator Beggs "the centerpiece" of his Aeronautical R&T program when introduced as a new initiative last year, grew another 56 percent to $26.5 million.

Space Research and Technology

Funding is up $13 million (9.5 percent) over FY 1984. $136 million of the total of $150 million is in the R&T base, which is up 8.5 percent over last year. There are no startling changes in any of the R&T base programs, which continue along on a level-of-effort basis. The $1 million Physics and Chemistry Experiments in Space (PACE) program in Multidisciplinary Research has been turned over to OSSA.

Space flight experiments represent the same 76 percent of the systems technology programs as they did last year, but some $2.1 million has been added as a new line item known as "Chemical Propulsion Systems Technology." This is to provide a testbed SSME which can be used to evaluate emerging technologies that could find early application in an improved SSME.

Tracking and Data Advanced Systems

A $1.1 million increase to $15.3 million is included to assess and make use of the dramatic changes taking place in the state of the art in telecommunications and computer technology.

Space Flight, Control and Data Communications

At $3.6 billion, this area represents nearly half of the FY 1985 budget request, and comprises the operational (non-R&D) portion of the budget: Shuttle production and operational capability, space transportation operations, and the space and ground command and data systems network.

Major FY 1985 efforts include delivery of OV-104 (Atlantis) in December 1984, modification of OV-102 (Columbia) to its full operational configuration, and modification of OV-104 and OV-099 (Challenger) to accept and deploy the new wide-bodied Centaur Upper Stage.

In FY 1985, the Tracking and Data Relay Satellite (TDRSS) will become the primary system for supporting upcoming earth-orbiting missions.

Construction of Facilities

The budget (not shown in the table) increased by $4.5 million to $160 million in FY 1985, a much smaller growth than in FY 1984. About one-fourth of the funds are for Space Shuttle and payload facilities at various locations, down from more than a third last year. The balance goes for construction and repair work at the centers.

Research and Program Management

The $1.331 billion budget (of which only the R&D portion shows up in the table) represents a 6 percent inflationary growth over FY 1984, but provides for no change in the 22,000 ceiling on the number of permanent Civil Service work-years anywhere within the agency. However, 600 recent science and engineering graduates were hired in 1983, replacing losses due to retirement and attrition, and reversing the rise in the average age of the technical work force.

Chapter 8

R&D in the Department of Agriculture

National Association of State Universities and Land-Grant Colleges
Dale Stansbury

The FY 1985 R&D budget request for the Department of Agriculture of $898.4 million is a 3.4 percent increase over the previous year but only 5.3 percent above FY 1983. The principal changes from FY 1984 include:

- A $14.1 million increase in the ARS research program.
- A $33 million increase competitive grants -- $28.5 million for biotechnology and $4.5 million for an animal science program.
- A $1.3 million increase for the National Agricultural Library.
- A $3.7 million increase for the Economic Research Service decreases.
- $11 million reduction in special research grants under CSRS.
- $6.3 million reduction in Forest Service research.
- $5.8 million reduction in graduate fellowships and higher education support under ARS.

Agricultural Research Service

The Agricultural Research Service is the primary science agency within USDA. ARS conducts basic and applied research in five general areas and provides scientific support for various USDA regulatory agencies. The higher education programs are included in the ARS line.

ARS Direct Programs
(Thousands of Dollars)

	1984 Estimated	1985 Estimated
Animal Science Research	$ 82,284	$ 84,917
Plant Science Research	185,195	$190,748
Soil and Water Conservation		
Processing, Storage, Distribution, Food Saftey, Research	89,599	93,156
Human Nutrition Research	34,147	34,392
Repair and Maintenance of Facilities	11,092	11,092
Higher Education Grants	7,800	2,000
Contingencies	1,000	1,000
Construction of Facilities	4,522	-
Total Direct Program	$479,280	$483,040

The research programs are slated generally for modest increases. No new construction activities are proposed for FY 1985. The greatest change is the higher education program area. In FY 1984, the Department conducted two Higher Education grant programs -- the $2.8 million Morrill-Nelson permanent appropriation, which provides $50,000 to every state and territory and the $5 million Competitive Fellowships Grant Program to attract future scientists and professionals to shortage areas in the food and agricultural sciences. In FY 1985, the Administration proposes legislation to eliminate the permanent Morrill-Nelson appropriation and proposes no funds for the fellowship program. A total proposed reduction of $7.8 million. However, the President's budget does include a proposed $2 million higher education program specifically for the historically black Land-Grant Colleges and Universities, Tuskegee Institute and the University of the District of Columbia.

Cooperative State Research Service

CSRS administers federal funds provided for research at the state agricultural experiment stations and other eligible institutions. The agency also participates in the nationwide system of research planning and coordination.

	CSRS Direct Programs (Thousands of Dollars)	
	FY 1984	FY 1985
Hatch Act Formula	$152,281	$155,326
1890 Colleges and Tuskegee Formula	22,844	23,300
Cooperative Forestry Formula	12,702	12,452
Special Research Grants	26,476	15,482
Competitive Research Grants	17,000	50,000
Plant Science	(15,000)	(15,000)
Human Nutrition	(2,000)	(2,000)
Animal Science	-	(4,500)
Biotechnology	-	(28,500)
Animal Health (Sec. 1433)	5,760	-
Fed. Admin. (Direct Approp.)	592	225
1890 Research Facilities	10,000	10,000
TOTAL, CSRS	$247,655	$266,785

As noted above, the budget provides a major increase in the Competitive Research Grants Program for biotechnology research and some increases in high priority formula grant programs. This budget request will strengthen the capacity of land-grant institutions (the traditional USDA cooperators) and other institutions to investigate the complex cellular and genetic processes of commercially important plant and animal species. However, a reduction is proposed for cooperative forestry while the animal health program along with $11 million of special grants are eliminated.

The reduction to cooperative forestry is more serious than it would seem given the magnitude of the cut -- $250,000. Forestry research in total has lagged over the past several years and the FY 1985 budget proposes a $6 million cut to Forest Service research. In all liklihood, the Forest Service would take most of this cut out of the research grants and contracts program. These two cuts represent a potential 25 to 30 percent reduction in total Federal support of university based forestry research. There are also cuts proposed for other resource conservation activitiies in USDA. In total, the proposed funding for natural resource programs at USDA is not consistent with national needs in this area.

Most of the special research programs that are proposed for elimination are relatively low priority items from a scientific perspective. Funding is requested for pesticide and animal drug clearance, pesticide impact assessment, animal health, germplasm resources, tropical and subtropical research, and acid precipitation. However, the proposed elimination of $3 million for integrated pest management research and a reduction in the Extension Service IPM program of $9.2 million will nearly destroy this national IPM effort -- a program that is increasingly important to the nation.

The elimination of the animal health research under Section 1433 of P.L. 95-113 is consistent with past administration proposals. Congress has restored the funds consistently, however, this process has precluded the development of a sound research program in line with national needs. The FY 1985 request does continue a $7.2 million animal health Special Grant program in CSRS. In addition, there is a new $4.5 million animal science program proposed in the competitive grants program of CSRS. However, neither of these provide the research capacity building potential of the Section 1433 funds.

Economic Research Service

ERS performs economic and other social science research, outlook forecasting, and policy analysis, related to U.S. and international agriculture, food, production resources, and rural America. The proposed FY 1985 budget of $47,480,000 would permit ERS to maintain activities at FY 1984 levels and provide for a program increase of $1,365,000 for research on agriculture and the macroeconomy.

Forest Service (Research)

Forest service research includes both intramural and extramural research programs. The two primary programs are land and resource protection research and renewable resource management and utilization research.

FS Direct Programs
(Thousands of Dollars)

	FY 1984	FY 1985
Land and Resource Protection Research	$ 48,454	$ 45,675
Renewable Resource Management and Utilization Research	60,949	57,395
Total	$109,403	$103,070

Most of the proposed reductions will probably be taken from the extramural programs. The overall effect of these reductions plus the cuts to cooperative forestry in CSRS and renewable resources extension would be a significant reduction in Federal forestry/renewable resources research and education efforts with the greatest impact being on the university research programs.

Agricultural Marketing Research

The two agencies most directly involved in agricultural marketing research are the Agricultural Cooperative Service and the Agricultural Marketing Service. The FY 1985 budget request would reduce the ACS R&D effort by $800,000 to $1.4 million and eliminate the AMS R&D program -- $1.5 million in FY 1984. The market bill for food and agriculture accounts for two-thirds of total food cost. The proposed R&D reduction in these agencies is inconsistent with the relative importance of marketing and with national needs.

Human Nutrition

The Human Nutrition Information Service is scheduled for a $1.3 million increase to a total of $7.9 million to expand the Department's National Nutrition Monitoring System. However, this would still be 300,000 less than in FY 1983. The nutrition research effort requested for ARS, noted above, is at $34.4 million and the CSRS program at$8 million are both about level with FY 1984. In contrast, a $25.5 million cut in the Expanded Food and Nutrition Education program in the Extension Service is requested.

On balance, the USDA human nutrition research and information request is not positive. However, the Department has initiated an intra-departmental human nutrition coordinating committee and in cooperation with HHS has initiated an inter-departmental human nutrition coordinating committee. Both efforts should enhance the quality of the national human nutrition research and information effort.

Information Service

A $1.3 million increase is requested for the National Agricultural Library, the second significant increase in two years. The proposed increase will facilitate the implementation of the NAL Interagency Blue Ribbon Committee's 1982 recommendations to improve collections, improve services, and to increase cooperation with the libraries.

The Statistical Reporting Service research request of $8.5 million will basically permit SRS to operate their R&D program on statistical techniques and use of satellite data at the same level as in FY 1984.

Chapter 9

R&D in the Environmental Protection Agency

American Association for the Advancement of Science
Albert H. Teich

Highlights

- For the first time in several years, EPA's R&D budget shows an increase (13.8 percent, to $278 million) rather than a decline.
- Acid rain research will more than double in FY 1985, to $34.4 million, incorporating a broad range of initiatives.
- R&D in toxic substances will increase 11.0 percent to $27.1 million; the additional funds will cover programs aimed at estimating risks posed by esposure to toxic chemicals, as well as bioengineered organisms.
- Hazardous waste research will increase by 7.6 percent reflecting growth in monitoring systems and quality assurance, and expansion of dioxin studies.
- Included in the FY 1985 air research program are a multi-disciplinary initiative to determine the contribution of air pollution to human cancer risk and an expanded epidemiology effort, including cooperative work with the People's Republic of China.

Introduction

Following two years of turmoil under former Administrator Anne Gorsuch Burford, the Environmental Protection Agency (EPA) changed course significantly during 1983. The shift began last March with the appointment of William D. Ruckelshaus as Administrator and the subsequent shake-up of EPA's top management and submission of a revised budget

request for FY 1984. Congress generally supported the revised request, providing an increase in EPA's total budget in place of the cut that had originally been requested. President Reagan underlined the turn-around in EPA's fortunes by announcing in his State of the Union address in January 1984 that EPA would receive "one of the largest" budget increases of any federal agency in FY 1985 -- although press accounts later revealed that the increase was well below what had been sought by Ruckelshaus.

EPA's total budget, $4.25 billion in FY 1985, includes three major components: construction grants to state and local governments for sewage treatment facilities ($2.40 billion), "Superfund" for control of hazardous wastes ($0.64 billion), and operating programs ($1.21 billion). R&D activities represent nearly a quarter of the agency's operating programs. Although EPA sees itself primarily as a regulatory agency and not an R&D agency, its ability to regulate and to assist industry, state and local governments, and other federal agencies in controlling pollution and restoring environmental quality depends heavily on scientific and technical data and competence. EPA's R&D programs provide the scientific basis for regulation and reflect its technical competence. They therefore receive considerable public attention and Congressional scrutiny.

The Office of Research and Development (ORD), which manages EPA's R&D efforts, has long been beset by problems. Throughout EPA's 14-year history ORD has had to balance pressures to be responsive to the immediate needs of EPA's regulatory program offices against its own needs to plan and conduct a coherent, scientifically credible R&D program. The new assistant administrator for R&D, Bernard Goldstein, appointed in late 1983, inherited an organization whose budget had shrunk considerably over the prior two years and whose staff was therefore being squeezed by personnel ceilings.

Raising morale and undertaking initiatives to restore scientific vitality to the agency's R&D programs under these circumstances poses a substantial challenge. Complicating the situation further is a tradition of headquarters micromanagement of EPA's 14 in-house laboratories, the lack of an effective long-range planning structure in ORD, and a complex system for defining research priorities and approving projects that requires building consensus among laboratory, ORD and regulatory program staff through a set of research

committees. The FY 1985 R&D budget for EPA, discussed below, reflects some important steps towards alleviating these problems, but also provides a sense of how long the road is that lies ahead.

R&D Budget Overview

EPA's FY 1985 budget contains a total of $278 million for R&D. This represents an increase of 13.8 percent over the FY 1984 current estimate of $244 million, but is still far below the FY 1981 level of $385 million. The FY 1985 budget documents display a remarkable change in tone compared to FY 1984. While in FY 1984 the agency justified continued cuts in terms of the completion of various programs and an effort to reduce funding for programs "not...directly relevant to EPA's legislative mandates," the FY 1985 Congressional submissions describe increases intended to improve the management of EPA's research and "strengthen the resource base" in order "to achieve environmental benefits." Four areas are given special emphasis: acid rain, understanding the risks posed by hazardous and toxic chemicals, assessing pollution control technologies, and improving the scientific basis for estimating health effects of pollutants.

R&D funds for EPA are contained in two appropriations categories: "Research and Development" (which covers extramural activities) and an R&D share of "Salaries and Expenses" (which covers mainly in-house research). Since many R&D programs contain closely-linked intramural and extramural components, the funds in these two categories are added together in our tables. EPA's R&D budget is presented in a matrix format, divided once by medium (air, water, hazardous waste, etc.) and simultaneously by program category (environmental engineering and technology, health effects, monitoring systems and quality assurance, etc.). These two breakdowns, which slice through the same funds in different ways, are presented in Tables II-21 and II-22.

Acid Rain Research

By far the most dramatic increase in EPA's R&D budget is in the area of acid rain research. This initiative, which was noted by the President in his State of the Union address, is reflected in a budget increase of 123.5 percent, from $15.4 million in FY 1984 to $34.4 million in FY 1985. In addition, (and not included in the figures in Table II-

22), the administration has requested a $5.5 million supplemental appropriation for this program for FY 1984. Research initiatives will include the following:

- development of a comprehensive field study to better define acidic deposition transport and transformation phenomena;
- establishment of monitoring stations to quantify air concentration levels for acid deposition precursors;
- enhancement of the National Trends Network for deposition monitoring;
- establishment of a long-term monitoring system to provide advance warning of acidification of aquatic and terrestrial ecosystems;
- completion of a national baseline survey of lake chemistry covering about 3,000 lakes and initiation of a similar survey for streams;
- initiation of a survey of forest damage; and
- initiation of an acid fog study to determine the chemical and physical phenomena of acid formation.

This acid rain research initiative is an outgrowth of a National Acid Precipitation Assessment Program undertaken by an interagency task force several years ago. EPA played an important role in this task force and in helping to focus national attention on the problem. Critics of the administration's environmental policies have charged, however, that the expanded EPA research effort for FY 1985 is a weak and politically expedient response to a problem whose dimensions are known and which requires regulatory action rather than more research.

Toxic Substances

R&D in toxic substances is slated to be increased by 11.0 percent, from $24.4 to $27.1 million. Emphasis will be placed on understanding and estimating the risks posed by exposure to toxic chemicals, both new and existing. Much of the increase is intended to support development of measurement methods for organic chemicals, particularly azo

dyes, to initiate a program of quality assurance in support of PCB regulations, and to develop improved exposure monitoring systems. Other expanded efforts will help develop predictive techniques and models in support of premanufacturing notice reviews, as required under the Toxic Substances Control Act.

Also included in the toxic substances area is a new research program on biotechnology concerned with the development of methodologies for evaluating environmental risks associated with bioengineered organisms. The program reflects concern within EPA about its role in the regulation of products associated with rapidly emerging applications of genetic engineering techniques. The agency is in the midst of an internal planning process aimed at developing a biotechnology research agenda.

Pesticides

Pesticides, a smaller R&D program closely allied with toxic substances in EPA's management structure, is to receive an increase of 27.7 percent, to $8.0 million in FY 1985. Emphasis in FY 1985 will be placed on several areas: (1) quality assurance -- recertifying the purity of chemical standards in EPA's Pesticide Repository and updating quality assurance manuals used by other laboratories; (2) developing health effects test methods and risk assessment models; and (3) a new program to provide procedures for selecting protective clothing materials to minimize exposure of those working with highly toxic pesticides.

Hazardous Waste

Hazardous waste, one of the larger areas of EPA R&D, is due for a modest (7.6 percent) increase to $34.8 million in FY 1985, following a small decline in FY 1984. Much of the work in this area is conducted in support of regulatory activities under the Resource Conservation and Recovery Act (RCRA). Included are:

- efforts aimed at developing techniques and procedures for characterizing wastes as hazardous or not hazardous for listing and delisting decisions under RCRA;

- efforts to develop technical data to support RCRA treatment, storage and disposal regulations, and permitting and enforcement activities; and

- efforts to develop techniques and procedures to prevent and contain hazardous materials releases.

A research program to assess the magnitude of the much-publicized dioxin problem, to assess related potential health and environmental effects, and to determine the efficacy and costs of potential control technologies is also being conducted under this budget category.

The largest element of the hazardous waste program and the largest increase ($10.1 million, up from $7.8 million) is in monitoring systems and quality assurance, where the additional funds will support the continuing validation of waste characterization analytical methods and validation of methods for instack monitoring. Dioxin monitoring will also be continued, as will a research program initiated in 1984 to develop sampling and analysis guidance at the parts per trillion or parts per quadrillion level for dioxin in air, water, soil, sediment and fish.

The FY 1985 request also includes an increase for the in-house element of a program which is developing a battery of short-term biological tests to use as prescreening techniques for characterizing health hazards of substances proposed for listing or delisting actions.

Air Research

The largest single element of EPA's research program has to do with air quality and supports the agency's regulatory mandates relating to oxidants, hazardous air pollutants, mobile sources of pollution (motor vehicles), and gases and particulates. In FY 1985, nearly a quarter of EPA's R&D budget will be devoted to this work. The proposed total, $65.2 million, represents an increase of 4.7 percent over FY 1984.

Among the areas emphasized in FY 1985 will be:

- animal tests of health and welfare effects (including pulmonary structure and function, ability to fight respiratory disease, and cardiovascular changes following exposure to oxidants) in support of review and revision of the National Ambient Air Quality Standards;

- reduction technologies for volatile organic compounds, which are a major cause of ozone non-attainment problems;

- efforts to prepare comprehensive health assessments for use by the Office of Air Quality Planning and Standards in hazardous air pollutant listing decisions;

- a multi-disciplinary initiative to determine the contribution of air pollution to human cancer risk in the United States;

- significant enhancement of the agency's epidemiology program, including a comprehensive study of the relationship between air pollution and lung disease in China which is being undertaken under a U.S.-China Protocol for Scientific and Technical Cooperation in Environmental Protection.

Water Quality and Drinking Water

EPA conducts administratively separate water quality and drinking water R&D programs. The water quality research program is scheduled to grow by 8.0 percent, to $26.8 million, in FY 1985, bringing it up to approximately half its FY 1982 level, while the drinking water program will decline very slightly, from $23.8 to $23.1 million.

The water quality research program includes three major elements: water quality research, municipal wastewater research and industrial wastewater reseach. The water quality research program is providing the scientific and technical base to help states implement site-specific standards through water quality permitting. The program is shifting its emphasis from development of single chemical criteria to development of methods required for permitting on water quality limited segments where there are multiple dischargers with complex effluents. Also, in FY 1985, EPA scientists will collaborate with Chinese scientists in work on the effects of pollution on freshwater organisms, pollution of soil and groundwater, and modeling of water pollution fate and transport. In addition, the agency will take part in a joint effort with NOAA and the Corps of Engineers to develop data to support what it terms "an environmentally-sound" ocean disposal program for various types of wastes.

In FY 1984, EPA's budget request included a sharp reduction in the municipal wastewater research program, noting that there are now major incentives for the private sector to develop innovative wastewater technology. The FY 1985 budget request reverses this position, asking for an increase for new efforts in the areas of compliance achievement, evaluation of the utility of various municipal treatment processes for treating toxics, and providing support for the water quality standards and permit processes.

The industrial wastewater program, which was cut back severely in FY 1984, will be increased by more than 30 percent in FY 1985. Environmental engineering and technology activities in this area, originally scheduled for termination in FY 1984, have been given new life in FY 1985, with an increase from $0.11 million to $0.95 million and the task of providing a data base to enable permitting authorities to issue "Best Professional Judgment" discharge permits for industry to meet water quality-based standards in the most cost-effective manner. Efforts will concentrate on complex, highly-toxic wastewaters, such as those from dye and pigment manufacturing, organic chemicals production, and aluminum smelters.

The drinking water research program conducted by EPA provides support to states and EPA's Office of Drinking Water in implementing the Safe Drinking Water Act. It provides data underpinning drinking water regulations, quality assurance support to drinking water monitoring laboratories, technical assistance to states and municipalities to aid in complying with drinking water regulations, and methods and data for protection of groundwater resources. Changes in FY 1985 include completion of funding for research on drinking water contamination from the pesticide Temik in Florida, and completion of funding of cooperative research with the water utility industry, as well as increases in epidemiology research and work on the health effects of drinking water disinfectants and their byproducts.

Interdisciplinary/Intermedia Programs

The intermedia research program includes four major activities:

- exploratory research, devoted to long-range projects conducted through grants and academic research centers, and including the Mussel Watch Toxics Trend Monitoring program and the new, small Senior Visiting Scientist program;

- technical information and liaison, the communications arm of the Office of Research and Development;

- scientific assessment, responsible for an important effort to develop uniform risk assessment guidelines for the agency; and

- quality assurance, responsible for centralized management of EPA's quality assurance program.

Beneficiary of a large increase resulting from consolidation of a variety of activities under its rubric last year, the intermedia program is slated for a small reduction in FY 1985, resulting from the transfer of the Economic Benefits program from ORD to the Office of Policy, Planning and Evaluation. The impact of this transfer is partly offset by small increases in exploratory research, risk assessment and quality assurance management. Although the more radical changes proposed for exploratory research in FY 1984 (which included the transfer of the grants program to NSF) have apparently been withdrawn, plans for FY 1985 do note the agency's intention to tie both the grants and the academic centers programs to a long-range research strategy. In the past, ties between the centers' research programs and EPA's research needs have been less than optimal.

Other Programs

The Superfund hazardous substance research program, funded at a proposed level of $12.7 million in FY 1985, primarily provides technical support to the Superfund program office based on R&D and expertise derived from EPA R&D programs. These efforts will grow in parallel with overall expansion of the Superfund program. Some of the increases in R&D will be used to support additional enforcement actions; others will evaluate technologies for assessing, managing, and cleaning up waste sites.

Radiation, the smallest of EPA's R&D areas, will grow by $0.3 million to $2.1 million in FY 1985. The additional funds will support increased health effects research on low

frequency radiation, filling gaps in the health data base underlying the current Federal Radiation Protection Guidelines for radio frequency and microwave radiation.

Tables

Table II-1. R&D in the FY 1985 Budget by Agency in Current Dollars
(budget authority in millions).

Conduct of R&D:	FY 1982 Actual	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 84-85 Current $	% Change FY 84-85 Constant $
Defense-Military	$20,539	$23,337	$27,399	$34,946	+27.5%	+21.7%
NASA	4,510	2,662	2,889	3,339	+15.6%	+10.4%
DOE	4,690	4,387	4,700	4,776	+1.6%	-3.2%
HHS	3,919	4,349	4,844	4,939	+1.9%	-2.7%
(NIH)	(3,433)	(3,793)	(4,236)	(4,342)	(+2.5%)	(-2.1%)
NSF	972	1,056	1,238	1,408	+13.7%	+8.6%
Agriculture	805	853	869	898	+3.4%	-1.2%
Interior	384	385	388	364	-6.0%	-10.2%
Transportation	297	348	488	491	+0.7%	-3.8%
EPA	285	234	248	280	+12.7%	+7.6%
Commerce	299	324	352	271	-23.0%	-26.4%
NRC	221	207	191	168	-11.8%	-15.8%
VA	139	157	220	195	-11.3%	-15.3%
AID	165	177	225	264	+17.2%	+11.9%
Labor	23	14	17	19	+10.5%	+5.5%
Education	129	102	111	104	-5.9%	-10.1%
TVA	30	21	24	27	+13.2%	+8.1%
Smithsonian	56	54	60	66	+9.8%	+4.8%
HUD	19	18	18	20	+10.3%	+5.4%
Corps of Engineers	29	29	28	34	+20.6%	+15.1%
Justice	28	34	44	44	-1.6%	-6.0%
FEMA	10	3	3	6	+87.9%	+79.4%
Treasury	9	9	12	14	+13.4%	+8.3%
Total Conduct of R&D	$37,556	$38,760	$44,368	$52,673	+18.7%	+13.1%

Table II-1, continued.

	FY 1982 Actual	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 84-85 Current $	% Change FY 84-85 Constant $
R&D Facilities:						
DOE[1]	$ 716	$ 778	$ 836	$ 990	+18.4%	+12.8%
Defense-Military	309	334	477	390	-18.3%	-22.1%
NASA[1]	79	73	82	127	+54.0%	+47.1%
Agriculture	25	32	54	28	-48.7%	-51.0%
HHS	20	22	33	15	-55.9%	-57.9%
(NIH)	(17)	(21)	(28)	(14)	(-50.4%)	(-52.6%)
NSF	2	3	9	18	+111.6%	+102.1%
Transportation	15	23	25	11	-56.4%	-58.3%
TVA	*	*	*	*	0.0	-4.5%
Commerce	*	1	*	12	+5,800.0%	+5,534.4%
VA	*	4	9	28	+221.6%	+207.1%
AID	6	7	6	5	-13.3%	-17.2%
Smithsonian	1	1	*	2	+466.7%	+441.2%
Interior	1	2	6	*	-96.5%	-96.6%
Education	0	0	0	3	--	--
Total R&D Facilities	$ 1,182	$ 1,282	$ 1,537	$ 1,628	+5.9%	+0.9%
Total R&D	$38,738	$40,042	$45,905	$54,301	+18.3%	+12.7%

Source: "OMB Data for Special Analysis K," as revised. Conversion to constant dollars by authors based on OMB deflators.
Columns may not add due to rounding; percentages calculated on unrounded numbers.
*Less than $0.5 million.
[1]Amounts for DOE and NASA reflect revisions following preparation of "Special Analysis K."

Table II-2. R&D in the Department of Defense - FY 1985 Budget (budget authority in millions).

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Research, development, test and evaluation:				
Research (6.1 category)[1]	$ 787.2	$ 839.7	$ 899.8	+7.2%
Exploratory development	2,450.9	2,202.5	2,326.5	+5.6%
Technology base	3,238.1	3,042.2	3,226.3	+6.1%
Advanced technology development	822.5	1,386.2	3,421.0	+46.8%
Strategic programs	5,825.2	7,842.7	8,735.2	+11.4%
Tactical programs	7,255.0	7,908.7	10,510.0	+31.2%
Intelligence and communications programs	2,708.6	3,404.2	4,215.7	+23.8%
Defense-wide mission support	2,975.4	3,284.2	3,876.8	+18.0%
TOTAL RDT&E	22,824.8	26,868.2	33,985.0	+26.5%
Other appropriations[2]	848.4	1,007.9	1,350.5	+34.0%
TOTAL DOD R&D	23,673.2	27,765.1	35,335.6	+26.8%
Total conduct of R&D	23,337.4	27,398.7	34,945.7	+27.5%
Total R&D facilities	335.8	477.4	389.9	-18.3%
TOTAL DOD R&D	$23,673.2	$27,876.1	$35,335.6	+26.8%

Source: FY 1985 Budget Appendix and OMB "Data for Special Analysis K," FY 1985 Budget.

[1] Does not include $30 million basic research funds contained in advanced technology development program.

[2] R&D support in military personnel, military construction and other appropriations.

Table II-3. DOD R&D by Military Departments and Agencies
(budget authority in millions).

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Research, development, test and evaluation:				
Army	$ 3,895.3	$ 4,259.4	$ 4,987.1	+17.1%
Navy	6,100.1	7,571.7	9,826.1	+29.8%
Air Force	10,621.2	12,220.7	14,401.9	+17.8%
Defense Agencies	2,153.2	2,767.4	4,707.9	+70.1%
Department of Defense	(29.1)	(96.0)	(1,846.1)	+1,823.0%
Defense Advanced Research Projects Agency	(728.6)	(864.1)	(714.5)	-17.3%
Defense Mapping Agency	(70.3)	(130.1)	(207.4)	+59.4%
Defense Communications Agency	(109.6)	(104.4)	(81.8)	-21.6%
Defense Nuclear Agency	(314.0)	(321.5)	(347.0)	+7.9%
Defense Logistics Agency	(20.0)	(21.6)	(26.3)	+21.8%
Defense Reconnaissance Support Program	(124.1)	(318.2)	(1,482.9)	+20.8%
Defense Intelligence Agency and National Security Agency	(755.7)	(909.7)		
Uniformed Services University of Health Sciences	(1.8)	(1.8)	(1.9)	+6.1%
Director of Test and Evaluation	55.0	49.0	62.0	+26.5%
Total RDT&E	22,824.8	26,868.2	33,985.0	+26.5%
Other appropriations[1]	848.4	1,007.9	1,350.6	+34.0%
TOTAL R&D	$23,673.2	$27,876.1	$35,335.6	+26.8%

Source: Department of Defense R,D,T&E Programs (R-1), February 1, 1984.

[1]Military personnel, military construction, and other.

Table II-4. Department of Defense R&D by Character of Work, FY 1985 Budget (budget authority in millions).

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Basic research	$ 787.2	$ 839.7	$ 929.6	+10.7%
Applied research	2,450.8	2,202.5	2,326.4	+5.6%
Total research	3,238.0	3,042.2	3,256.0	+7.0%
Development	20,099.4	24,356.5	31,689.7	+30.1%
Total conduct of R&D	23,337.4	27,398.7	34,945.7	+27.5%
R&D facilities	335.8	477.4	389.9	-18.3%
TOTAL R&D	$23,673.2	$27,876.1	$35,335.6	+26.8%

Source: OMB "Data for Special Analysis K."

Table II-5. Basic Research in the Department of Defense - FY 1985 Budget (budget authority in millions).

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Defense Research Sciences (grants and contracts):				
Army	$ 184.3	$ 195.6	$ 214.3	+9.6%
Navy	284.3	295.9	324.0	+9.5%
Air Force	154.7	179.4	190.1	+5.9%
Defense Advanced Research Projects Agency	104.3	108.6	102.5	-5.6%
Total	727.6	779.5	830.9	+6.6%
In-House Laboratory Independent Research				
Army	21.9	21.9	24.5	+12.0%
Navy	23.3	23.4	25.7	+9.5%
Air Force	12.6	13.1	16.8	+28.7%
Uniformed Services University of Health Sciences	1.8	1.8	1.9	+6.1%
Total	59.6	60.2	68.9	
Subtotal, 6.1 category	787.2	839.7	899.8	+7.2%
Included in Advanced Technology Development (6.3A)	0.0	0.0	29.8	--
TOTAL DOD Basic Research (Spec. Anal. K)	$ 787.2	$ 839.7	$ 929.6	+10.7%

Source: DOD R,D,T&E Programs (R-1), February 1, 1984 and OMB "Data for Special Analysis K," FY 1985 Budget.

Table II-6. Department of Defense Funding for Basic Research by Discipline[1] (budget authority in millions).

	FY 1982 Actual	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Physics, radiation sciences, astronomy and astrophysics	$ 76.0	$ 80.9	$ 87.2	$ 96.6	+10.8%
Mechanics, aeronautics and energy conversion	73.1	79.5	86.3	92.2	+6.8%
Materials	71.5	81.0	82.8	87.5	+5.7%
Electronics	90.0	90.5	97.9	93.7	-4.3%
Oceanography	51.1	50.2	53.4	57.5	+7.7%
Biology and medical sciences	64.9	66.3	79.8	86.7	+8.6%
Chemistry	53.1	58.9	62.0	66.3	+6.9%
Mathematics and computer sciences	83.3	98.8	111.7	124.9	+11.8%
Terrestrial sciences, geophysical research	24.3	29.0	30.8	33.9	+10.1%
Atmospheric sciences	20.8	21.8	25.0	28.2	+12.8%
Behavioral sciences, human resources	33.9	33.6	35.2	36.3	+3.1%
Special studies	--	2.0	--	--	--
University instrumentation	--	30.2	30.0	30.0	0.0
In-house laboratory independent research	54.1	57.5	58.4	67.0	+14.7%
TOTAL	$ 696.1	$ 780.0	$ 839.3	$ 899.9	+7.2%

Source: Department of Defense, Office of the Under Secretary of Defense for Research and Engineering.

[1]Consists of funds classified under budget category "6.1." Includes support for the Defense Advanced Research Projects Agency (DARPA) and the Uniformed Services University of the Health Sciences.

Table II-7. Department of Defense Funding for Basic Research by Discipline: Army[1] (budget authority in millions).

	FY 1982 Actual	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Physics	$ 18.5	$ 19.0	$ 19.1	$ 22.1	+15.7%
Mechanics and energy conversion	7.5	8.1	8.4	5.6	-33.3%
Materials	14.8	17.0	17.1	18.1	+5.8%
Electronics	20.3	22.9	22.6	27.5	+21.7%
Biology and medical sciences	36.9	38.3	50.6	53.5	+5.7%
Chemistry	22.2	23.8	23.5	25.4	+8.1%
Mathematics and computer sciences	13.8	14.7	15.1	16.0	+6.0%
Terrestrial sciences	5.3	5.9	6.7	7.5	+11.9%
Atmospheric sciences	5.5	5.8	7.8	9.1	+16.7%
Behavioral sciences	4.2	5.3	5.2	7.2	+38.5%
Aeronautical sciences	7.6	7.7	9.6	12.4	+29.2%
Special studies	—	2.0	—	—	—
University instrumentation	—	10.0	10.0	10.0	0.0
In-house laboratory independent research	21.5	21.9	21.9	24.5	+11.9%
TOTAL	$ 178.1	$ 202.4	$ 217.5	$ 238.8	+9.8%

Source: Department of Defense, Office of the Under Secretary of Defense for Research and Engineering.

[1]Consists of funds classified under budget category "6.1."

Table II-8. Department of Defense Funding for Basic Research by Discipline: Navy[1]
(budget authority in millions).

	FY 1982 Actual	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Physics	$ 30.5	$ 33.4	$ 34.9	$ 38.3	+9.7%
Radiation	3.0	3.4	3.5	3.9	+11.4%
Astronomy and astrophysics	4.0	4.1	4.3	4.7	+9.3%
Mechanics	18.2	20.3	21.1	23.2	+10.0%
Energy conversion	10.0	11.4	11.9	13.1	+10.1%
Materials	24.2	24.0	25.0	27.5	+10.0%
Electronics	27.1	27.9	29.1	32.0	+10.0%
Oceanography	51.1	50.2	53.4	57.5	+7.7%
Biology and medical sciences	17.9	17.7	18.5	20.3	+9.7%
Chemistry	17.1	18.2	19.0	20.9	+10.0%
Mathematics	21.7	29.1	30.4	33.4	+9.9%
Terrestrial sciences	14.4	17.7	18.5	20.3	+9.7%
Atmospheric sciences	6.4	6.4	6.7	7.4	+10.4%
Behavioral and social sciences	9.1	10.3	10.7	11.8	+10.3%
University instrumentation	--	10.0	10.0	10.0	0.0
In-house laboratory independent research	21.3	23.0	23.4	25.7	+9.8%
TOTAL	$ 276.0	$ 307.3	$ 319.3	$ 349.7	+9.5%

Source: Department of Defense, Office of the Under Secretary of Defense for Research and Engineering.

[1]Consists of funds classified under budget category "6.1."

Table II-9. Department of Defense Funding for Basic Research by Discipline: Air Force[1] (budget authority in millions).

	FY 1982 Actual	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Physics	$ 14.7	$ 15.7	$ 19.7	$ 20.3	+3.0%
Astronomy and astrophysics	5.3	5.3	5.7	7.3	+28.1%
Mechanics	20.5	21.5	23.5	23.8	+1.3%
Energy conversion	9.3	10.1	11.8	14.1	+19.5%
Materials	18.1	17.7	21.9	22.7	+3.7%
Electronics	16.2	16.7	21.0	21.7	+3.3%
Biology and medical sciences	8.1	8.3	9.3	10.9	+17.2%
Chemistry	13.8	16.9	19.5	20.0	+2.6%
Mathematics	12.7	15.1	18.1	19.4	+7.2%
Terrestrial sciences	2.4	2.3	2.7	2.9	+7.4%
Atmospheric sciences	8.9	9.6	10.5	11.2	+6.7%
Human resources	6.2	5.3	5.7	5.8	+1.8%
University instrumentation	—	10.2	10.0	10.0	0.0
In-house laboratory independent research	11.3	12.6	13.1	16.8	+28.2%
TOTAL	$ 147.5	$ 167.3	$ 192.5	$ 206.9	+7.5%

Source: Department of Defense, Office of the Under Secretary of Defense for Research and Engineering.

[1]Consists of funds classified under budget category "6.1."

Table II-10. Department of Defense Funding for Basic Research by Discipline: Defense Advanced Research Projects Agency[1] (budget authority in millions).

	FY 1982 Actual	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Materials	$ 14.4	$ 22.3	$ 18.8	$ 19.2	+2.1%
Electronics	26.4	23.0	25.2	12.5	-50.4%
Computer sciences	35.1	39.9	48.1	56.1	+16.6%
Geophysical research	2.2	3.1	2.9	3.2	+10.3%
Behavioral sciences	14.4	12.7	13.6	11.5	-15.4%
TOTAL	$ 92.5	$ 101.0	$ 108.6	$ 102.5	-5.6%

Source: Department of Defense, Office of the Under Secretary of Defense for Research and Engineering.

[1]Consists of funds classified under budget category "6.1."

Table II-11. Trends in Department of Defense R&D, FY 1965 - FY 1985 (budget authority in millions).

	Basic Research [1]		Total DOD R&D [2]	
	Current Dollars	Constant FY 1972 $	Current Dollars	Constant FY 1972 $
Fiscal Years				
1965	$347	$531	$ 6,865	$ 10,510
1970	323	379	7,491	8,779
1975	305	238	9,167	7,114
1980	552	290	14,150	7,443
1981	615	287	16,772	7,816
1982	697	298	20,866	8,909
1983	787	317	23,233	9,456
1984 (est.)	840	330	28,082	11,036
1985 (budget)	930	349	34,221	12,833

Sources: National Science Foundation historical reports and OMB "Data for Special Analysis K." Constant Dollar conversions by authors using OMB deflators.

[1] Budget authority for DOD (6.1) category. FY 1985 amount includes $30 million from advanced technology development program.

[2] Obligations for conduct of R&D and R&D facilities.

Table II-12. R&D in the National Science Foundation
(budget authority in millions).

	FY 1983 Actual	FY 1984 Current Plan	FY 1985 Budget	% Change FY 1984-85
MATHEMATICAL AND PHYSICAL SCIENCES				
Mathematical Sciences	$ 34.8	$ 41.5	$ 50.5	+21.7%
Computer Research	29.3	33.9	39.3	+15.9%
Physics	89.2	105.9	121.8	+15.0%
Chemistry	67.6	80.0	92.1	+15.1%
Materials Research	81.1	97.5	113.0	+15.9%
International Awards[1]	-1.5			
Total	300.5	358.8	416.7	+16.1%
ENGINEERING				
Electrical, Computer, and Systems Engineering	29.5	36.0	44.7	+24.2%
Chemical and Process Engineering	22.6	26.6	32.5	+22.2%
Civil and Environmental Engineering	30.5	33.8	39.8	+17.8%
Mechanical Engineering and Applied Mechanics	19.4	24.3	30.1	+23.9%
International Awards[1]	-0.9			
Total	$101.1	$120.7	$147.1	+21.9%

Table II-12, continued.

	FY 1983 Actual	FY 1984 Current Plan	FY 1985 Budget	% Change FY 1984-85
BIOLOGICAL, BEHAVIORAL AND SOCIAL SCIENCES				
Physiology, Cellular and Molecular Biology	$ 87.3	$102.1	$116.4	+14.0%
Biotic Systems and Resources	46.0	53.4	59.9	+12.2%
Behavioral and Neural Sciences	34.0	38.5	42.2	+9.6%
Social and Economic Sciences	20.3	24.6	28.0	+13.8%
Information Science and Technology	5.5	6.1	6.6	+8.2%
International Awards[1]	-1.9			
Total	191.2	224.7	253.1	+12.6%
ASTRONOMICAL, ATMOSPHERIC, EARTH AND OCEAN SCIENCES				
Astronomical Sciences	62.7	78.2	93.4	+19.4%
Atmospheric Sciences	75.5	89.3	98.6	+10.4%
Earth Sciences	34.9	41.5	48.6	+17.1%
Ocean Sciences	102.5	113.7	124.9	+9.9%
Arctic Research Program	6.2	7.4	8.0	+8.1%
International Awards[1]	-1.0			
Total	$280.8	$330.1	$373.5	+13.1%

Table II-12, continued.

	FY 1983 Actual	FY 1984 Current plan	FY 1985 Budget	% Change FY 1984-85
SCIENTIFIC, TECHNOLOGICAL AND INTERNATIONAL AFFAIRS				
Industrial Science and Technological Innovation	$ 14.5	$ 17.6	$ 23.4	+33.0%
International Cooperative Scientific Activities	4.6	5.5	5.5	0.0
Policy Research and Analysis	4.3	4.6	4.7	+2.2%
Science Resources Studies	3.6	4.2	4.3	+2.4%
Research Initiation and Improvement	11.8	8.9	9.0	+1.1%
International Awards[1]	+5.3			
Total	44.1	40.8	46.9	+15.0%
PROGRAM DEVELOPMENT AND MANAGEMENT	65.7	66.6	70.9	+6.5%
U.S. ANTARCTIC PROGRAM	83.2	102.4	115.1	+12.4%
SCIENCE AND ENGINEERING EDUCATION	16.1	88.9[2]	75.7	-14.8%

Table II-12, continued.

	FY 1983 Actual	FY 1984 Current plan	FY 1985 Budget	% Change FY 1984-85
SPECIAL FOREIGN CURRENCY APPROPRIATION (RESEARCH)	3.1	2.9	2.8	-3.4%
TOTAL, NSF	$1,085.8	$1,335.9	$1,501.8	+12.4%
Deduct Science Education other than R&D	-16.1	-83.9	-70.7	-15.7%
TOTAL, NSF R&D	$1,069.7	$1,252.0	$1,431.1	+14.3%

Source: Agency budget justification.

[1]Obligations actually incurred under the Scientific, Technological and International Affairs activity; shown with research activities for comparison of FY 1983 with FY 1984 and FY 1985.

[2]Includes carryover of $13.9 million from FY 1983.

Table II-13. R&D in the Department of Health and Human Services
(budget authority in millions).

Conduct of R&D	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Health				
National Institutes of Health	$3,792.7	$4,236.3	$4,341.9	+2.5%
Alcohol, Drug Abuse and Mental Health Administration	302.1	345.6	355.3	+2.8%
Centers for Disease Control	78.1	83.5	84.0	+0.6%
Food and Drug Administration	74.2	79.3	81.0	+2.1%
Office of Assistant Secretary for Health	16.4	17.8	16.2	-9.0%
Health Care Financing Administration	20.0	23.0	23.0	0.0
Health Resources and Services Administration	9.2	10.2	5.4	-47.1%
Total, Health	4,292.7	4,795.7	4,906.8	+2.3%
Human Services				
Office of Human Development Services	24.4	20.5	5.9	-71.2%
Social Security Administration	17.0	18.1	16.6	-8.3%
Departmental Management	14.7	10.0	8.5	-15.0%
Total, Human Services	56.1	48.6	31.0	-36.2%
Total, conduct of R&D	$4,348.8	$4,844.3	$4,937.8	+1.9%

Table II-13, continued.

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
R&D facilities				
National Institutes of Health	$ 21.0	$ 27.6	$ 13.7	-50.4%
Alcohol, Drug Abuse and Mental Health Administration	0.1	1.5	0.0	-100.0%
Food and Drug Administration	0.9	3.8	0.8	-78.9%
Total, R&D facilities	22.0	32.9	14.5	-55.9%
TOTAL, HHS R&D	$4,370.8	$4,877.2	$4,952.3	+1.5%

Source: "OMB Data for Special Analysis K."

Table II-14. R&D in the National Institutes of Health[1] (budget authority in millions).

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Cancer	$ 959.1	$1,049.8	$1,074.1	+2.3%
Heart, Lung and Blood	596.0	672.8	689.0	+2.4%
Dental	75.1	84.0	86.9	+3.5%
Arthritis, Diabetes, Digestive and Kidney Diseases	393.5	442.7	455.5	+2.9%
Neurological and Communicative Disorders and Stroke	286.7	325.1	334.4	+2.9%
Allergy and Infectious Diseases	270.3	305.2	316.2	+3.6%
General Medical Sciences	319.4	365.2	373.9	+2.4%
Child Health and Human Development	243.3	264.2	269.6	+2.0%
Eye	137.8	150.6	154.1	+2.3%
Environmental Health Sciences	157.8	172.7	177.6	+2.8%
Aging	91.2	112.2	114.2	+1.8%
Research Resources	213.2	241.9	244.9	+1.2%
Fogarty International Center	10.1	11.3	11.4	+0.9%
National Library of Medicine	16.4	14.1	14.8	+5.0%
Office of the Director	22.8	24.5	25.3	+3.3%
TOTAL	$3,792.7	$4,236.3	$4,341.9	+2.5%

Source: National Institutes of Health.

[1]Excludes training and buildings and facilities.

Table II-15. R&D and Related Activities in the National Institutes of Health, by Mechanism

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
	Amount (budget authority in millions)			
Research grants				
Research projects	$2,096.0	$2,386.9	$2,489.9	+4.3%
Noncompeting	[1,435.4]*	[1,649.0]	[1,755.4]	[+6.5%]
Administrative supplementals	[16.4]	[14.7]	[14.1]	[-4.0%]
Competing	[644.2]	[723.2]	[720.3]	[-0.4%]
Research centers	373.4	425.5	424.3	-0.3%
Other research grants	218.2	244.6	244.1	-0.2%
Total, research grants	2,687.6	3,057.0	3,158.2	+3.3%
Training[1]	164.7	166.5	164.1	-1.5%
R&D contracts	320.3	331.8	326.7	-1.5%
Intramural research	500.9	537.0	546.4	+1.7%
Research management and support[2]	199.7	216.6	215.3	-0.6%
Disease control	53.6	63.7	63.9	+0.4%
Construction	3.0	2.1	2.0	-5.2%
National Library of Medicine	52.3	50.2	51.3	+2.2%
Office of the Director	25.7	27.3	27.5	+0.6%
Buildings and facilities	17.5	25.0	11.1	-55.7%
Total, NIH	$4,025.3	$4,477.3	$4,566.5	+2.0%

Table II-15, continued.

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
	Number of grants			
Research grants				
Research projects	16,921	17,202	17,094	-0.6%
Noncompeting	[11,532	[11,930	[12,094	[+1.4%
Administrative supplementals	(385)	(492)	(479)	(-2.6%)
Competing	5,389]	5,272]	5,000]	-5.2%]
Research centers	481	503	505	+0.4%
Other research grants	2,605	2,700	2,612	-3.3%
Total, research grants	20,007	20,405	20,211	-1.0%
Training[1]	10,570	9,863	9,000	-8.7%
R&D contracts	1,117	1,133	1,079	-4.8%

*Bracketed numbers total to the entry immediately above.

[1] Numbers reflect full-time equivalent trainees.

[2] Formerly direct operations and program management.

Table II-16. Research in the Alcohol, Drug Abuse and Mental Health Administration[1] (budget authority in millions).

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
General mental health	$158.7	$181.3	$177.6	-2.0%
Drug Abuse	47.5	54.7	63.5	+16.1%
Alcoholism	33.0	42.9	47.8	+11.4%
Total	$239.2	$278.9	$288.9	+3.6%

Source: Agency budget justification.

[1]Excludes training, community programs, and "buildings and facilities."

Table II-17. R&D in the Department of Energy (budget authority in millions; includes plant and capital equipment)

DOE Appropriations Containing R&D	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
1. Energy Supply R&D	$2,051.9	$1,935.1	$1,905.5	-1.5%
2. Fossil Energy R&D	310.9	329.5	272.8	-17.2%
3. Energy Conservation	130.1	156.4	168.0	+7.4%
4. General Science and Research	569.4	641.3	746.8	+16.5%
5. Atomic Energy Defense Activities	1,975.1	2,285.5	2,521.9	+10.3%
6. Uranium Enrichment	124.2	189.3	150.0	-20.8%
7. Departmental Administration	9.6	6.3	6.8	+7.9%
TOTAL, DOE R&D	$5,171.2	$5,543.4	$5,771.8	+4.1%

Table II-17, continued.

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
1. Energy Supply R&D				
Solar				
Solar building energy systems	$ 11.6	$ 16.5	$ 11.9	-27.8%
Photovoltaic energy systems	57.9	50.4	47.5	-5.8%
Solar thermal energy systems	49.4	43.9	37.5	-14.5%
Biofuels energy systems	20.9	28.4	28.1	-1.1%
Wind energy systems	31.4	26.5	23.3	-12.1%
Ocean energy systems	10.5	5.5	3.5	-36.4%
International solar energy program	10.0	0.5	0.5	0.0
Solar technology transfer	3.0	3.3	6.0	+84.6%
Program support	1.0	0.8	0.5	-37.5%
Program direction	5.9	6.0	4.9	-18.9%
Adjustments	+0.3	—	—	--
TOTAL, Solar	201.9	181.7	163.6	-9.9%
Geothermal	57.6	30.5	27.1	-11.1%
Hydropower	2.0	0.8	0.5	-37.5%

Table II-17, continued.

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Nuclear				
Conventional reactor systems	$ 78.3	$ 92.7	$ 83.5	-9.9%
High temperature reactors	[35.2] *	[30.0]	[34.6]	[+15.4%]
Light water reactors	10.0	19.5	16.0	-17.9%
Three Mile Island activities	28.8	37.0	32.2	-13.0%
Advanced reactors	4.2	5.0	0.0	-100.0%
Program direction	0.4	1.2	0.7	-39.1%
Adjustments	-0.2	—	—	—
Nuclear waste technology	17.8	14.3	13.3	-6.8%
Remedial actions	18.7	43.8	56.3	+28.5%
Advanced nuclear systems	38.9	34.1	33.5	-1.8%
Space and special applications	[31.5]	[27.7]	[28.0]	[+0.8%]
Advanced systems evaluation	6.4	5.0	4.5	-10.0%
Program direction	1.0	1.4	1.1	-23.4%
Breeder reactor systems	584.1	423.2	308.1	-27.2%
Liquid metal fast breeder	[302.0]	[300.8]	[261.6]	[-13.0%]
Clinch River Breeder Reactor	193.9	40.0[1]	0.0[1]	-100.0%
Nuclear fuel cycle	35.4	35.4	11.9	-66.3%
Water cooled breeder	45.0	35.5	26.3	-25.9%
Program direction	8.0	11.5	8.3	-27.9%

Table II-17, continued.

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Civilian radioactive waste R&D[2]	30.5	14.2	27.7	+95.1%
Spent fuel storage R&D	[6.4]	[5.0]	[13.2]	[+164.0%]
Alternative disposal concepts	6.0	4.7	12.0	+155.3%
Generic methods and supporting studies	17.9	1.6	2.2	+35.9%
Program direction	0.1	0.1	0.3	+104.6%
Adjustments	[+0.1]	[+2.8]	[+0.1]	[--]
Policy and Management	1.6	1.9	1.5	-18.5%
TOTAL, Nuclear	$769.9	$624.2	$523.9	-16.1%

*Bracketed numbers total to entry immediately above.

[1]An appropriation transfer of $40.0 million was made from Uranium Enrichment as an interim measure to fund CRBR termination. Resolution of final budget authority sources to fund termination (estimated at $115.0 million) is still pending.

[2]Civilian radioactive waste R&D integrates existing DOE waste management activities and new programs provided for by the Nuclear Waste Policy Act of 1983.

Table II-17, continued.

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Magnetic fusion	$461.3	$470.8	$483.1	+2.6%
Electric energy systems	17.2	18.5	18.2	-1.4%
Energy storage systems	25.7	25.7	18.9	-26.5%
Environmental R&D	184.6	184.0	189.1	+2.8%
Liquified Gaseous Fuels	3.5	3.3	2.0	-39.4%
Basic Energy Sciences				
Materials sciences	119.7	154.3	188.7	+22.2%
Chemical sciences	75.9	82.5	97.8	+18.6%
Nuclear sciences	32.2	40.3	53.0	+31.5%
Applied mathematical sciences	14.7	15.6	29.8	+90.2%
Engineering and geosciences	18.3	20.2	22.3	+10.6%
Advanced energy projects	8.6	9.4	11.1	+18.3%
Biological energy research	9.9	11.0	13.1	+18.9%
Program direction	3.2	4.0	3.8	-3.5%
TOTAL, Basic Energy Sciences	282.4	337.3	419.5	+24.4%
Energy research analyses	1.9	2.0	2.0	0.0
University research support	6.0	5.5	9.2	+68.2%
University research instrumentation	0.0	4.0	6.0	+50.0%
General purpose facilities	34.0	42.1	39.0	-7.5%
Program direction	2.6	3.4	2.9	-14.7%
Policy and management	1.3	1.3	0.5	-58.9%
TOTAL, Energy Supply R&D	$2,051.9	$1,935.1	$1,909.5	-1.5%

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Table II-17, continued.

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
2. Fossil Energy R&D				
Coal	$266.8	$276.3	$224.8	-18.6%
Petroleum	29.1	36.3	37.9	+4.4%
Gas	15.0	16.9	10.1	-40.2%
TOTAL, Fossil Energy R&D	$310.9	$329.5	$272.8	-17.2%
3. Energy Conservation				
Buildings and community systems	$ 39.0	$ 37.4	$ 35.3	-5.6%
Industrial energy conservation	27.9	33.7	33.3	-1.2%
Transportation energy conservation	53.8	65.0	51.1	-21.5%
Multisector	12.7	12.8	26.5	+107.8%
Policy and Management and Policy Analysis	1.2	2.0	1.8	-12.3%
Adjustments	-4.5	+5.5	-20.0	—
TOTAL, Energy Conservation R&D	$130.1	$156.4	$168.0	+7.4%
4. General Science and Research				
High energy physics	$431.0	$480.0	$561.0	+16.9%
Nuclear physics	137.0	159.0	183.6	+15.5%
Program direction	1.4	2.3	2.2	-2.0%
TOTAL, General Science and Research	$569.4	$641.3	$746.8	+16.5%

Table II-17, continued.

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
5. Atomic Energy Defense Activities				
Inertial confinement fusion	$ 189.8	$ 169.7	$ 138.0	-18.7%
Naval reactors development	377.3	423.0	456.9	+8.0%
Weapons R&D and testing	1,039.5	1,270.9	1,510.8	+18.9%
Verification and control technology	19.8	21.4	25.7	+20.1%
Waste management R&D and technology	188.0	219.0	184.8	-15.6%
Security and safeguards	45.2	49.5	58.7	+18.6%
Materials production	115.5	132.0	147.0	+11.4%
TOTAL, Atomic Energy Defense Activities	$1,975.1	$2,285.5	$2,521.9	+10.3%
6. Uranium Enrichment				
Uranium Enrichment [3]	$ 124.2	$ 189.3	$ 150.0	-20.8%
TOTAL, Uranium Enrichment	$ 124.2	$ 189.3	$ 150.0	-20.8%
7. Departmental Administration				
Policy analysis and systems studies	$ 9.6	$ 6.3	$ 6.8	+7.9%
TOTAL, Departmental Administration	$ 9.6	$ 6.3	$ 6.8	+7.9%
TOTAL, DOE R&D	$5,171.2	$5,543.4	$5,771.8	+4.1%

Source: "OMB Data for Special Analysis K," as revised, and agency budget justification.

[3] Includes R&D related to uranium resource assessment, enrichment activities, and advanced isotope separation technology.

Table II-18. Department of Energy Funding to Multiprogram National Laboratories (obligations in millions).

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Ames Laboratory	$ 17.2	$ 17.0	$ 17.2	+1.3%
Argonne National Laboratory	215.3	208.7	198.0	-5.2%
Brookhaven National Laboratory	162.0	174.1	200.2	+15.0%
Hanford Engineering Development Laboratory	425.6	497.0	493.3	-0.8%
Idaho National Engineering Laboratory	113.6	119.4	149.8	+25.4%
Lawrence Berkeley Laboratory	104.8	127.4	145.9	+14.5%
Lawrence Livermore Laboratory	565.0	574.5	669.3	+16.5%
Los Alamos Scientific Laboratory	515.5	560.5	629.2	+12.3%
Oak Ridge National Laboratory	293.1	304.2	300.6	-1.2%
Pacific Northwest Laboratory	73.6	82.0	84.6	+3.2%
Sandia Laboratories	649.0	731.4	821.4	+12.3%
Savannah River Laboratory	122.3	182.8	173.3	-5.2%
Total	$3,257.0	$3,579.0	$3,882.8	+8.5%

Source: Department of Energy, Office of Energy Research.

Table II-19. National Aeronautics and Space Administration:
Amounts for R&D and Total NASA Budget
(budget authority in millions).

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Summary				
Conduct of R&D:				
"Research and Development" Appropriation	$1,902.5	$2,028.2	$2,400.1	+18.3%
"Research and program management" appropriation	759.1	860.7	939.3	+9.1%
Total, Conduct of R&D	2,661.6	2,888.9	3,339.4	+15.6%
R&D Facilities[1]	73.1	82.2	126.6	+54.0%
Total NASA R&D	2,734.7	2,971.1	3,466.0	+15.7%
R&D Support Costs[2]	1,590.0	1,710.0	1,790.0	+4.7%
Total NASA R&D and R&D Support	4,324.7	4,681.1	5,256.0	+12.3%
All Other NASA	2,513.0	2,536.4	2,235.4	-11.8%
Total NASA Budget	$6,837.7	$7,217.5	$7,491.4	+3.8%

[1] AAAS estimates.
[2] AAAS rough estimates of launch and operations costs supporting R&D.

Table II-19, continued.

Detail by Appropriation and Program	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Conduct of R&D:				
"Research and Development" Appropriation:				
Space Transportation:				
Space Station	$ (4.0)[3]	$ (14.0)[3]	$ 150.0	+71.4%
Spacelab	121.2	112.3	69.3	-38.4%
Shuttle Upper Stages	167.0	147.2	92.4	-35.5%
Eng. and Tech. Base	70.3	93.1	105.7	+13.5%
Payload Ops. and Support Equip.	44.4	59.6	61.3	+2.9%
Advanced Programs	12.6	20.0	14.5	-27.5%
Tethered Satellite System	--	3.3	18.2	+451.5%
Total Space Transportation	$ 415.5	$ 431.7	$ 511.4	+18.5%
Physics and Astronomy:				
Space Telescope Dev.	$ 182.5	$ 195.6	$ 195.0	-.3%
Gamma-ray Obs. Dev.	34.5	86.2	120.2	+39.4%
Shuttle/Space Lab Payload Dev. and Mission Management	81.0	80.9	105.4	+30.3%
Explorer Satellite Dev.	34.3	48.7	51.9	+6.6%
Mission Ops. and Data Analysis	61.4	68.1	109.1	+60.2%
Research and Analysis	28.5	35.8	36.9	+3.1%
Suborbital Programs	48.1	52.3	58.7	+12.2%
Total, Physics and Astronomy	$ 470.3	$ 567.6	$ 677.2	+19.3%

[3] Funded in other programs in FY 1983 and FY 1984.

Table II-19, continued.

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Planetary Exploration:				
Galileo (Jupiter) Dev.	$ 91.6	$ 79.5	$ 56.1	-29.4%
Venus Radar Mapper Dev.	--	29.0	92.5	+219.0%
Internat. Solar Polar Mission	6.0	6.0	9.0	+50.0%
Mars Geoscience/Climatology Orbiter (MGCO)	--	--	16.0	--
Mission Ops. and Data Analysis	38.5	43.4	58.8	+35.5%
Research and Analysis	50.3	59.5	54.5	-8.4%
Total, Planetary Exploration	$ 186.4	$ 217.4	$ 286.9	+32.0
Life Sciences:				
Flight Experiments	$ 24.0	$ 23.0	$ 27.1	+17.8%
Research and Analysis	31.7	35.0	36.2	+3.4%
Total, Life Science	55.7	58.0	63.3	+9.1%
Solid Earth Observations:				
Landsat 4	58.4	16.8	--	-100.0%
Extended Mission Ops.	1.1	--	--	
Shuttle/Spacelab Paylods	14.5	16.0	18.1	+13.1%
Geodynamics	28.1	28.0	29.9	+6.8%
AgRISTARS	15.0	--	--	--
Research and Analysis	11.8	14.6	15.6	+6.8%
Total, Solid Earth Obs.	$ 128.9	$ 75.4	$ 63.6	-15.6%

Table II-19, continued.

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Environmental Observations:				
Upper Atmosphere Res. Sat.	$ 14.0	$ 20.0	$ 60.7	+203.5%
Shuttle/Spacelab Payloads	3.7	7.6	7.8	+2.6%
Earth Radiation Budget Exp.	24.0	15.5	8.1	-47.7%
Extended Mission Ops.	22.8	27.4	29.5	+7.7%
Operational Satellite Improvements	6.0	.6	--	-100.0%
Tethered Satellite Payloads	--	--	3.0	--
Scatterometer Dev. (Oceanog.)	--	--	15.0	--
Research and Analysis:				
Upper Atmosphere	27.7	28.5	31.0	+8.8%
Atmos. Dynamics and Radiation	26.5	27.5	28.5	+3.6%
Oceanic Processes	17.0	18.2	19.4	+6.6%
Space Physics	15.2	16.7	16.7	--
Interdisciplinary	--	--	1.0	--
Total, Environmental Obs.	156.9	162.0	220.7	+36.2%
Other Space Applications:				
Materials Processing in Space	$ 22.0	$ 23.6	$ 23.0	-2.5%
Advanced Communications Technology Satellite	20.0	5.0	5.0	--
Other Communications R&D	12.4	16.1	15.6	-3.1%
Information Systems R&D	7.5	8.9	16.2	+82.0%
Total, Other Space Applic.	$ 61.9	$ 53.6	$ 59.8	+11.6%

Table II-19, continued.

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Technology Utilization:				
Technology Dissemination	$ 5.8	$ 5.5	$ 5.8	+5.5%
Technology Applications	3.2	3.5	3.7	+5.7%
Total, Technology Util.	9.0	9.0	9.5	+5.6%
Aeronautical Research and Technology:				
Research and Technology Base	198.5	215.8	233.3	+8.1%
Systems Technology Programs	81.5	86.5	109.1	+26.1%
Total, Aeronautical Research and Technology	280.0	302.3	342.4	+13.3%
Space Research and Technology:				
Research and Technology Base	116.3	125.4	136.0	+8.5%
Systems Technology Programs	5.2	7.0	9.1	+30.0%
Standards and Practices	3.0	4.6	4.9	+6.5%
Total, Space Research and Technology	124.5	137.0	150.0	+9.5%
Space Tracking and Data Systems:				
Advanced Systems	13.4	14.2	15.3	+7.7%
TOTAL, "Research and Development" Appropriation	$1,902.5	$2,028.2	$2,400.1	+18.3%

Table II-19, continued.

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Research and Program Management Appropriation:				
Space Transportation	$ 108.1	$ 114.3	$ 142.6	+24.8%
Physics and Astronomy	143.8	176.1	187.2	+6.3%
Planetary Exploration	19.0	16.0	15.4	-3.8%
Life Sciences	22.3	21.8	23.2	+6.4%
Solid Earth Obs.	32.5	30.8	32.9	+6.8%
Environmental Obs.	56.6	58.3	65.0	+11.5%
Other Applications	26.3	28.0	30.3	+8.2%
Technology Utilization	4.8	3.8	3.9	+2.6%
Aeronautical Res. and Tech.	247.3	300.8	314.4	+4.5%
Space Res. and Tech.	96.5	108.2	121.6	+12.4%
Tracking and Data Acq.	2.9	2.6	2.8	+7.7%
TOTAL, "Research and Program Management" Appropriation	759.1	860.7	939.3	+9.1%
Total Conduct of R&D	$2,666.1	$2,888.9	$3,339.4	+15.6%
R&D Facilities	73.1	82.2	126.6	+54.0%
Total NASA R&D	$2,734.7	$2,971.1	$3,466.0	+16.7%

Table II-20. R&D in the Department of Agriculture
(budget authority in millions).

Conduct of R&D	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Agricultural Research Service	$445.9	$452.9	$466.9	+3.1%
Cooperative Research Service	234.9	237.7	256.8	+8.0%
Competitive research grants	[17.0]*	[17.0]	[50.0]	[+194.1%]
Agricultural experiment stations	[149.2]	[152.3]	[155.3]	[+2.0%]
Cooperative forestry research	[12.4]	[12.7]	[12.5]	[-1.6%]
1890 colleges and Tuskegee	[22.4]	[22.8]	[23.3]	[+2.2%]
Special research grants	[27.8]	[26.5]	[15.5]	[-41.5%]
Animal health and disease research	[5.8]	[5.8]	[0.0]	[-100.0%]
Administration and adjustments	[0.3]	[0.6]	[0.2]	[-66.7%]
Forest Service	107.7	108.7	103.0	-5.2%
Economics Research Service	39.0	44.3	47.5	+7.2%
Agricultural Cooperative Service	2.2	2.2	1.4	-36.4%
Agricultural Marketing Service	1.5	1.5	0.0	-100.0%
Office of International Cooperation and Development	5.2	5.4	5.4	0.0
Office of Transportation	0.8	1.0	1.0	0.0
Human Nutrition Information Service	8.2	6.6	7.9	+19.7%
Statistical Reporting Service	7.6	8.2	8.5	+3.7%
Total, conduct of R&D	$853.0	$868.5	$898.4	+3.4%

Table II-20 USDA 149

Table II-20, continued.

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
R&D facilities				
Agricultural Research Service	$ 21.3	$ 43.8	$ 16.1	-63.2%
Cooperative Research Service	10.0	10.0	10.0	0.0
Forest Service	0.5	0.4	1.7	+325.0%
Total R&D facilities	31.8	54.2	27.8	-48.7%
Total, USDA R&D	$884.8	$922.7	$926.2	+0.4%

Source: "OMB Data for Special Analysis K" and agency budget justification.

*Bracketed numbers total to entry immediately above.

Table II-21. R&D in the Environmental Protection Agency by Media
(budget authority in millions).

Media	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
"R&D" appropriation and R&D portion of "Salaries and Expenses" approp.				
Air	$ 60.0	$ 62.3	$ 65.2	+4.7%
Water Quality	31.6	24.8	26.8	+8.0%
Drinking Water	21.8	23.8	23.1	-2.8%
Hazardous Waste	33.4	32.3	34.8	+7.6%
Pesticides	6.1	6.3	8.0	+27.7%
Radiation	1.5	1.8	2.1	+18.3%
Interdisciplinary	9.2	20.9	20.4	-2.2%
Toxic Substances	26.8	24.4	27.1	+11.0%
Energy	26.7	30.4	48.5	+59.3%
Superfund	6.8	8.8	12.7	+45.0%
Program Management and Support	8.3	8.5	9.3	+8.5%
TOTAL	$232.3	$244.3	$278.0	+13.8%

Source: Agency budget justification.

Table II-22. R&D in the Environmental Protection Agency by Program (budget authority in millions).

Program	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Health Effects	$ 41.1	$ 49.7	$ 53.5	+7.7%
Environmental Processes and Effects	49.3	46.9	46.5	-0.8%
Monitoring Systems and Quality Assurance	35.9	36.9	42.2	+14.5%
Acid Deposition	13.1	15.4	34.4	+123.5%
Scientific Assessment	7.4	10.9	11.9	+8.7%
National Center for Toxicological Research	2.1	0.0	0.0	0.0
Technical Information and Liaison	2.7	2.6	2.6	+1.5%
Great Lakes Study	2.5	2.5	2.5	+0.4%
Stratospheric Modification	0.8	0.9	0.9	+0.3%
Environmental Engineering and Technology	62.7	53.0	58.4	+10.2%
Exploratory Research Core Program	6.5	16.9	15.7	-7.2%
Management and Support	8.3	8.6	9.4	-9.0%
TOTAL	$232.3	$244.3	$278.0	+13.8%

Source: Agency budget justification.

Table II-23. R&D in the Department of the Interior
(budget authority in millions).

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Conduct of R&D				
Geological Survey	$147.1	$161.0	$148.1	-8.0%
Fish and Wildlife Service	104.3	106.4	112.1	+5.4%
Bureau of Mines	96.6	87.2	68.9	-21.0%
Bureau of Reclamation	15.9	11.2	11.5	+2.7%
National Park Service	10.8	12.5	13.7	+9.6%
Office of Surface Mining Reclamation and Enforcement	1.5	1.0	3.0	+200.0%
Bureau of Land Management	7.4	6.3	5.2	-17.5%
Minerals Management Service	1.5	1.5	1.8	+20.0%
Office of the Secretary	0.0	0.4	0.0	-100.0%
Total, conduct of R&D	385.1	387.5	364.3	-6.0%
R&D facilities				
Geological Survey	1.4	1.3	0.2	-84.6%
Fish and Wildlife Service	1.0	4.4	0.0	-100.0%
Total, R&D facilities	2.4	5.7	0.2	-96.5%
Total, Interior R&D	$387.5	$393.2	$364.5	-7.3%

Source: "OMB Data for Special Analysis K."

Table II-24. R&D in the Department of Transportation
(budget authority in millions).

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Conduct of R&D				
Federal Aviation Administration	$127.4	$272.1	$277.3	+1.9%
National Highway Traffic Safety Administration	49.3	53.5	62.9	+17.6%
Urban Mass Transportation Administration	57.7	49.2	38.4	-22.0%
Federal Highway Administration	49.1	51.8	59.5	+14.9%
Federal Railroad Administration	17.0	16.2	15.7	-3.1%
Maritime Administration	16.7	12.6	4.2	-66.7%
Coast Guard	20.0	22.5	23.5	+4.4%
Research and Special Programs Administration	6.1	4.7	2.6	-44.7%
Office of the Secretary	4.9	4.9	6.8	+38.8%
Total, conduct of R&D	348.2	487.5	490.9	+0.7%
R&D facilities				
Federal Aviation Administration	22.7	23.8	10.1	-57.6%
National Highway Traffic Safety Administration	0.5	0.5	0.5	0.0
Total, R&D facilities	23.2	24.3	10.6	-56.4%
Total, DOT R&D	$371.4	$511.8	$501.5	-2.0%

Source: "OMB Data for Special Analysis K."

Table II-25. R&D in the Department of Commerce
(budget authority in millions).

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Conduct of R&D				
National Oceanic and Atmospheric Administration	$212.6	$239.6	$166.8	-30.4%
National Bureau of Standards	93.5	95.0	91.2	-4.0%
National Telecommunications and Information Administration	8.9	8.3	8.6	+3.6%
Bureau of the Census	3.6	3.7	4.1	+10.8%
Economic Development Administration	5.0	5.0	0.0	-100.0%
General Administration	0.5	0.6	0.6	0.0
Total, conduct of R&D	324.1	352.2	271.3	-23.0%
R&D facilities				
National Bureau of Standards	0.9	0.2	11.8	+5,800.0%
Total, R&D facilities	0.9	0.2	11.8	+5,800.0%
Total, Commerce R&D	$325.0	$352.4	$283.1	-19.7%

Source: "OMB Data for Special Analysis K."

Table II-26. R&D in the Department of Education
(budget authority in millions).

	FY 1983 Actual	FY 1984 Est.	FY 1985 Budget	% Change FY 1984-85
Educational Research and Statistics[1]	$ 64.2	$ 57.0	$ 63.0	+10.5%
National Institute of Handicapped Research	31.6	36.0	30.1	-16.4%
Bilingual Education	3.7	3.7	3.7	0.0
Handicapped Research -- Innovation and Development	12.0	15.0	12.0	-20.0%
Vocational and Adult Education	7.7	8.2	na[2]	--
Special Foreign Currency	0.5	1.1	0.0	-100.0%
All other	10.3	10.3	na[3]	--
Total	$130.0	$131.3	$123.9	-5.6%

Source: Agency budget justification and "OMB Data for Special Analysis K."

[1] Includes National Institute of Education
[2] Programs proposed for consolidation; not itemized in budget request.
[3] Insufficient detail to estimate, but included in total.

Part III: Disciplinary Analyses

Introduction

The chapters which follow take a rather different view of the FY 1985 figures for R&D than the preceding agency chapters -- summarizing the R&D prospects for some of the major scientific and engineering disciplines. In each case, the budgets of various agencies which provide support for these disciplinary areas are examined, and policy issues and funding trends are discussed in terms of their impacts on the disciplines. Tables in these chapters, on the whole, contain detail of agency R&D programs not shown in the tables that appear at the end of Part II.

Chapter 10

Social and Behavioral Research in the FY 1985 Budget

American Psychological Association, Virginia Holt
American Anthropological Association, Daniel D. Whitney
American Educational Research Association, David Florio

The FY 1985 budget once again presents an uneven funding picture for social and behavioral science research. Increases proposed for a number of social and behavioral science programs are offset by funding cuts affecting others. Modest growth, often less than inflation allowances, continues to hamper these science fields.

Social and behavioral science research is supported by thirteen cabinet level departments and eighteen independent agencies, according to data collected by the National Science Foundation. Funding for many of these programs was reduced dramatically in the Reagan administration's first budget, and in many cases, these programs are still struggling to regain the funding levels of FY 81.

Highlights of the FY 85 budget for social and behavioral science research include:

- The Alcohol, Drug Abuse and Mental Health Administration research budget is proposed for healthy increases in drug and alcohol abuse programs, while mental health research declines slightly as a result of the elimination of demonstration activities. Programs of interest to social and behavioral scientists in the National Institutes of Health are scheduled for generally modest increases, while major problems in R&D funding continue to plague the Office of Human Development Services.

- There is mixed news in the educational research and related activities budget. The administration restored $6 million of the $7 million cut from the

FY 84 budget of the National Institute of Education. Funding of research and related efforts in precollege mathematics and science education at the National Science Foundation will continue. However, the administration is also proposing substantial cuts in other educational research programs for the handicapped, bilingual education and international education.

- Behavioral and social science research at the National Science Foundation, while increased over the last two fiscal years, is still not supported at pre-Reagan administration levels. Within NSF, the Behavioral and Neural Science division received the second lowest increase in the Foundation for FY 85. The proportionately large increases in the Social and Economic Sciences division, while promising on the surface, will be spent largely on an extension of socioeconomic data resources, rather than research.

The summary and estimates above are based on the tables and text that follow. The source of information for all tables is the Fiscal Year 1985 Budget of the United States Government and its Appendix. When available, these materials were supplemented by agency-prepared budget justification documents and explanations from informed agency officials.

The Department of Health and Human Services (DHHS)

As other sources of funding for behavioral and social science research continue to shrink, the Department of Health and Human Services assumes a more important role in the support of these science fields. Most DHHS programs that fund behavioral or social science research received modest increases in the proposed FY 1985 budget. There are exceptions, however, including healthy increases in drug and alcohol abuse programs, as well as significant reductions proposed for R&D in human development services. Please see Table 1 for a summary of DHHS behavioral and social science research funding.

The Alcohol, Drug Abuse and Mental Health Administration (ADAMHA), is the largest source of funding for behavioral and social science in DHHS. Two of its components, the drug abuse and alcohol institutes, are tapped for rather remarkable increases in times of constrained domestic spending. These increases are offset somewhat by proposed decreases in the research budget for mental health.

The National Institute of Mental Health (NIMH) extramural research budget will decrease slightly (3.1 percent) from FY 84 if the administration's proposal is approved. This is due almost entirely to the elimination of funding for demonstration projects; all other extramural research programs are scheduled for small increases. NIMH will focus its extramural research efforts on studies of schizophrenia, childhood disorders, prevention, the neurosciences, and depression.

The National Institute on Drug Abuse (NIDA) extramural research budget for FY 85 provides an increase of nearly 18 percent over FY 84 levels. This is the largest proportional increase for an extramural research budget in the Public Health Service, of which ADAMHA and the National Institutes of Health are the largest components. Treatment of narcotic addiction, prevention of drug abuse, and abuse of cocaine and other stimulants are among the research focal points for NIDA. Roughly half of the extramural research funds support programs of interest to behavioral and social scientists.

The National Institute on Alcohol Abuse and Alcoholism (NIAAA) continues to experience healthy growth in its extramural research budget, with an increase over FY 84 levels of 14 percent. In just two years, NIAAA's extramural research budget has increased by $14 million, or more than 54 percent. FY 85 research plans indicate an emphasis on the prevention of alcohol abuse and alcoholism, and familial, cultural and occupational factors in alcoholism.

Although the National Institutes of Health (NIH) is best known as the federal agency responsible for biomedical research, the various institutes also support many millions of dollars in behavioral and social science research. The interdisciplinary nature of NIH supported research does not reveal the extent of behavioral and social research sponsored; unofficial estimates indicate $100 million or more may be devoted to these fields of study. Those institutes with the best identified behavioral or social science programs are shown on Table 1. They support such diverse research topics as behavioral risk factors for older persons, contributions of risk-taking behavior to the etiology and onset of disease, stress and cancer development, biobehavioral sequelae of hypertension, behavioral factors in pain, and the psychophysics of vision.

Table 1.
DEPARTMENT OF HEALTH AND HUMAN SERVICES
Programs of Interest to Behavioral and Social Scientists

(Budget Authority in Millions of $)

	FY 83 actual	FY 84 estimate	FY 85 estimate	FY 84 to FY 85 change $	FY 84 to FY 85 change %
ALCOHOL, DRUG ABUSE AND MENTAL HEALTH ADMINISTRATION					
National Institute of Mental Health Extramural Research	$107.0	$127.8	$123.9	$-3.9	-3.1%
National Institute on Drug Abuse Extramural Research	43.0	49.1	57.8	8.7	17.7
National Institute on Alcohol Abuse and Alcoholism Extramural Research	25.8	34.9	39.8	4.9	14.0
NATIONAL INSTITUTES OF HEALTH					
Cancer Cancer Control	56.6	65.9	66.5	.6	.9
Heart, Lung and Blood Heart and Vascular Diseases	358.1	404.5	414.9	10.4	2.6

Table 1 continued

(Budget Authority in Millions of $)

	FY 83 actual	FY 84 estimate	FY 85 estimate	FY 84 to FY 85 change $	FY 84 to FY 85 change %
Dental Research					
Disorders of Structure, Function and Behavior	$ 15.5	$ 17.1	$ 18.7	$ 1.6	9.4%
Arthritis, Diabetes & Digestive and Kidney Diseases					
Digestive Diseases and Nutrition	60.8	70.8	73.1	2.3	3.2
Neurological and Communicative Disorders and Stroke					
Biological Basis Research	139.9	157.5	162.8	5.3	3.4
Clinical Research	96.4	112.9	116.1	3.2	2.8
Child Health and Human Development					
Research for Mothers and Children	123.3	134.6	137.5	2.9	2.2
Population	86.2	91.9	93.8	1.9	2.1
Eye					
Strabismus, Amblyopia & Visual Processing	26.7	29.1	30.2	1.1	3.8
Aging					
Aging Research	70.4	87.1	89..6	2.5	2.8

Table 1 continued

(Budget Authority in Millions of $)

	FY 83 actual	FY 84 estimate	FY 85 estimate	FY 84 to FY 85 change $	FY 84 to FY 85 change %
OFFICE OF THE ASSISTANT SECRETARY FOR HEALTH					
National Center for Health Services Research	$ 16.3	$ 18.8	$ 17.3	$-1.5	-8.0%
HEALTH CARE FINANCING ADMINISTRATION					
Research, Demonstrations and Evaluation Projects	29.9	31.0	35.0	4.0	12.9
HUMAN DEVELOPMENT SERVICES					
Administration on Aging					
Research, Training & Discretionary Programs	22.2	22.2	5.0	-17.2	-77.5
Human Resources Research & Demonstration	22.0	9.0	4.3	-5.0	-53.8
SOCIAL SECURITY ADMINISTRATION					
Research and Evaluation	3.0	3.0	2.6	-.4	-13.3

Nearly all the NIH extramural research programs of interest to behavioral and social scientists are scheduled for small increases in line with the NIH budget as a whole.

The Office of the Assistant Secretary for Health is the organizational location of the National Center for Health Services Research. The proposed FY 85 budget of $17.3 million, 8 percent lower than the FY 84 funding level, may constrain the sponsorship of such research as the use of computer technology in health care delivery, and competition and productivity in the health marketplace.

The Health Care Financing Administration (HCFA) program for research, demonstrations and evaluation projects is slated for a $4 million increase, nearly 13 percent higher than in FY 84. This program sponsors research focusing on efficiency, cost effectiveness and cost containment in the provision of Medicare and Medicaid services.

At the Office of Human Development Services (OHDS), the administration will try once again to reduce funding for the Administration on Aging's research program; the FY 85 proposal of $5 million represents a proposed reduction of over 77 percent from FY 84. The administration proposed an identical reduction for FY 84, but Congress restored funding to the program. Human Resources Research and Demonstration, responsible for research on child welfare, child abuse prevention, adoption opportunities, and beginning with FY 85, research on the Head Start program, would be reduced by nearly 54 percent, from $9.3 million to $4.3 million for FY 85.

The small research program for the Social Security Administration will decrease by 13.3 percent in FY 85, if the administration's budget proposal is approved. This program sponsors research to develop knowledge for evaluation and implementation of major policy and program changes in the social security system.

National Science Foundation (NSF)

The National Science Foundation funds most social and behavioral science research within the Directorate of Biological, Behavioral, and Social Sciences (BBS). BBS is slated for a 12.7 percent increase above FY 84, from $224.7 to $253.1 million; this is the second lowest percentage increase among NSF programs (see Table 2). BBS includes many programs in the biological sciences and the FY 85 budget earmarks them to receive 83 percent of the new money ($23.7 of $28.4 million). Although all BBS social and

Table 2.
NATIONAL SCIENCE FOUNDATION
Programs of Interest to Social and Behavioral Scientists

(Budget Authority in Millions of $)

	FY 83 actual	FY 84 current	FY 85 estimate	FY 84 to FY 85 change $	FY 84 to FY 85 change %
DIRECTORATE OF BIOLOGICAL, BEHAVIORAL, & SOCIAL SCIENCES (BBS)					
Division of Behavioral & Neural Sciences (BNS)					
Neuroscience (other than Psychobiology)	$ 17.5	$ 20.3	$ 23.1	$ 2.8	14.0%
Psychobiology	3.9	4.2	4.4	.2	5.0
Memory & Cognitive Processes	2.3	2.6	2.8	.2	8.0
Social & Developmental Psychology	2.3	2.6	2.7	.1	4.0
Linguistics	2.2	2.4	2.5	.1	4.0
Anthropology	6.0	6.4	6.8	.4	6.0
Total, BNS	$ 34.0	$ 38.5	$ 42.3	$ 3.8	10.0%
Division of Social & Economic Sciences (SES)					
Economics	$ 7.2	$ 9.4	$ 10.3	$ .9	10.0%
Geography	.8	1.0	1.3	.3	30.0
Sociology	2.5	3.0	3.7	.7	23.0
Measurement Methods	3.3	3.6	3.4	-.2	-.1
History of Science	1.1	1.4	1.6	.2	14.0
Political Science	2.4	2.8	3.6	.8	29.0
Law & Social Science	1.2	1.4	1.7	.3	21.0

Table 2 continued

(Budget Authority in Millions of $)

	FY 83 actual	FY 84 current	FY 85 estimate	FY 84 to FY 85 change $	FY 84 to FY 85 change %
Regulation & Policy Analysis	.9	1.1	1.3	.2	18.0
Decision & Management Sciences	.9	1.0	1.2	.2	20.0
Total, SES	$ 20.3	$ 24.6	$ 28.0	$ 3.4	14.0%
Division of Information Science & Technology	$ 5.5	$ 6.1	$ 6.6	$ .5	8.0%
Other Divisions in BBS	133.3	155.5	176.3	20.8	13.0
Total, BBS	$191.2	$224.7	$ 253.1	$ 28.4	13.0%
SCIENCE AND ENGINEERING EDUCATION (SEE)					
Graduate Research Fellowships	$ 15.0	$ 20.3	$ 21.0	$ .7	3.0%
PreCollege Science & Math Education	1.1	54.7	54.7	0	0
Total, SEE	$ 16.1	$ 75.0	$ 75.7	$ .7	1.0%

behavioral science categories, except measurement methods, are due to increase, the overall increase of $4.7 million is $.6 million less than FY 84 (not shown in table). While the two main social and behavioral science divisions of BBS, Behavioral and Neural Sciences (BNS) and Social and Economic Sciences (SES), are slated for increases, funding levels are still below FY 81 funding levels; even with two years of increases, earlier allocations are yet to be reached. The third social and behavioral science research division, Information Sciences, is scheduled for an 8 percent increase, from $6.1 million to $6.6 million. Information Science is the only BBS division to exceed FY 81 levels.

The main social and behavioral research emphases in the NSF FY 85 budget include the study of human origins, the learning process, and the development of cognitive capabilities, including language. Also receiving priority are the extension of key socioeconomic data resources and strengthening related methodological and theoretical research.

Science and Engineering Education rebounded to $75 million in FY 84 after appropriations of $21 million in FY 82 and $30 million in FY 83. The FY 85 budget request is essentially the same as the Congressional appropriation for FY 84, with a small $.7 million increase in graduate research fellowships. The majority of funding, $54.7 million, will continue to fund precollege education efforts in science, mathematics and technology. The FY 85 funding allocation has not been determined; however, the current plan emphasizes R&D in teaching and learning, studies of education programs, materials development, and related inquiry and demonstrations.

Education Department (ED)

The Reagan Administration's budget for educational research is better but still not good. Compared to last year, Reagan has increased his request for the National Institute of Education (NIE). The budget proposal for NIE, $54.2 million, is not even up to the 1983 level, let alone the pre-Reagan 1980 level of $74.1 million. However, the $6 million, 12.4 percent increase restores most of the FY 84 cut of $7 million accepted by Congress last year.

The administration's budget goal for NIE is "Strengthening America's Classrooms" through funding of existing commitments and initiatives in three areas: (1) improving education software and the use of education

Table 3.
EDUCATION DEPARTMENT
Programs of Interest to Behavioral and Social Scientists

(Budget Authority in Millions of $)

PROGRAM	FY 83 actual	FY 84 estimate	FY 85 estimate	FY 84 to FY 85 change $	FY 84 to FY 85 change %
National Institute of Education	$ 55.6	$ 48.2	$ 54.2	$ 6.0	12.4%
National Center for Educational Statistics	8.6	8.8	8.8	0.0	0.0
Educ. Handicapped Innnov. & Development (R&D)	12.0	15.0	12.0	-3.0	-20.0
Educ. Handicapped Special Studies	.5	3.1	2.0	-1.1	-35.5
National Institute of Handicapped Research	31.6	36.0	30.1	-5.9	-16.4
Bilingual Educ. Study and Evaluation	5.3	4.7	3.6	-1.1	-23.4
Voc. Educ. Prog. of National Significance	7.7	8.2	*	*	*
Voc. Educ. Improvement & Support	99.6	99.6	*	*	*
Fund for the Improvement of Postsecondary Educ.	11.7	11.7	11.7	0.0	0.0
International Education (domestic)	21.0	25.8	0.0	-25.8	-100
ESFA Title I (Chap. 1) Eval. & Study	4.8	4.8	5.8	1.0	20.8
Educ. Consolidation (Chap. 2)	479.4	479.4	728.9	249.5	52.0
(state/local block grant)	(450.7)	(450.7)	(685.7)	(235.)	52.1
(6% set aside for Secretary of Education)	(28.8)	(28.8)	(43.2)	(14.4)	50.0
Follow Through	19.4	14.8	0.0	-14.8	-100
Women's Education Equity	5.8	5.8	0.0	5.8	-100
Civil Rights Training and Advisory	24.0	24.0	0.0	24.0	-100

*The Administration is proposing a vocational education block grant with a $15.3 million set aside for national programs (includes R&D and improvement).

technology, (2) enhancing the recruitment, selection and training of teachers, and (3) discovering what makes secondary schools effective. No funds would be available for R&D grants competitions or for assistance and cooperative research for education agencies and institutions undergoing reform efforts.

The administration's FY 85 budget proposal reduces applied research programs in the Department of Education. FY 85 research and related cuts are in the areas of education of the handicapped (from $18 million to $14 million, when "special studies" are included); rehabilitation/handicapped research in the National Institute of Handicapped Research ($30 million from $36 million in FY 84); and bilingual education studies ($3.6 million from $4.7 million). No funding is requested for research related programs like International Education (loss of $25.8 million), Follow Through (loss of $14.8 million), Women's Equity (loss of $5.8 million), and Civil Rights Assistance (loss of $24 million). In the past, Congress has rejected these efforts to abolish equity and international education assistance programs.

The Reagan proposal to make Vocational Education a block grant makes funding requests for research and related efforts unclear. In the past, research, development, demonstration, and employment information programs have been funded through the Programs of National Significance and through state Improvement and Support grants. Administration budget officials indicate that a set aside for "national purposes" in the block grant could include $8.6 million for research, information, development, and related activities.

Finally, there is a likelihood that some additions in the Secretary's Chapter 2 Discretionary Fund would support research efforts to use research for school reform and applied studies. Chapter 2 is increased by 52 percent from $480 million to $729 million. The Secretary has 6 percent ($43 million compared to $29 million in FY 84) and state education agencies may set aside up to 20 percent of the state block grant funds for their improvement initiatives. The secretary is already funding a limited number of reform efforts and devotes about $10 million of his fund for the National Diffusion Network.

Department of Defense (DoD)

The Department of Defense is the largest source of federal funding for research and development in the federal

government, and is a major supporter of social and behavioral science research, which DoD terms "people-related" research.

Throughout the services, R&D efforts and funding are categorized by type of effort, using the following designations: 6.1-basic research; 6.2-exploratory development (applications of basic research); 6.3-advanced development; and 6.4-prototype development. Most university-based behavioral scientists are interested in the 6.1 and 6.2 research; from 80 to 90 percent of 6.1 support in the behavioral sciences funds extramural research, and about 50 percent of 6.2 monies support extramural work. The overall FY 84 budget for people-related research is $254 million, of which about one-third falls in the 6.1 and 6.2 categories. FY 85 budget figures for these program levels were not available at this writing, although budget figures probably will not differ greatly from FY 84 funding. Because there is much concern in Congress about the size of the defense research budget, and competition for funding is increasing, DoD's people-related research budget may face difficult times in maintaining its funding levels.

Other Agencies

Social and behavioral science research at the Department of Interior is funded mainly in the National Park Sevice. Park Service R&D increased $1.2 million from its FY 84 total of $12.5 million (see Table 4).

For the past several years, 10-15 percent of the Department of Agriculture's R&D spending has been in the social and behavioral sciences. The largest Agriculture Department R&D increase is in the Human Nutrition Information Service (+23 percent), with the Cooperative State Research Service and Economic Research Service increasing $19.1 million (8 percent) and $3.2 million (7 percent).

The Japan-United States Friendship Commission, which sponsors scholarly and cultural studies and activities between Japan and the U.S., is slated for a decrease of $.1 million in its funding for FY 85, should the administration proposal be approved.

The Agency for International Development and the Smithsonian Institution allocate substantial portions of their budgets for social and behavioral research. Both are scheduled for increases in FY 85, with AID receiving an

additional $48.1 million (21 percent) more than FY 84 and Smithsonian an additional $7.6 million (12 percent).

The Department of Transportation funds social and behavioral science research in several of its R&D components. Table 4 shows funding levels for those programs that have been the main sources of support in past years. Urban Mass Transportation is notable in the $10 million proposed reduction from FY 84 funding.

Funding for R&D is increased in both the Department of Housing and Urban Development and the Department of Justice. Approximately $9 million of HUD's $21 million (up 10 percent) will be spent on the American Housing Survey. The National Institute of Justice is now included in the Office of Justice Research which has budgeted $38.2 million (up 6 percent from FY 84) for research, evaluation, and statistics.

The National Endowment for the Humanities (NEH) supports scholarly study and research on the humanities. For FY 85, NEH research programs are proposed for reductions of from $.5 million to nearly $3 million dollars from FY 84 funding levels. FY 85 emphases will be placed on stimulating nonfederal support of the humanities, improvement of humanities education and the advancement of research and scholarship.

Table 4.
OTHER AGENCIES
Programs of Interest to Social and Behavioral Scientists

(Budget Authority in Millions of $)

	FY 83 actual	FY 84 current	FY 85 estimate	FY 84 to FY 85 change $	FY 84 to FY 85 change %
DEPARTMENT OF INTERIOR					
National Park Service	$ 10.8	$ 12.5	$ 13.7	$ 1.2	10.0%
DEPARTMENT OF AGRICULTURE					
Agricultural Cooperative Service	4.6	4.6	3.6	-1.0	-22.0
Agricultural Research Service	460.6	478.8	483.0	8.2	2.0
Cooperative State Research Service	244.9	247.7	266.8	19.1	8.0
Economic Research Service	39.0	44.3	47.5	3.2	7.0
Human Nutrition Information Service	8.2	6.1	7.5	1.4	23.0
Forest Service	107.7	109.4	103.1	-6.3	-6.0
JAPAN-UNITED STATES FRIENDSHIP COMMISSION	1.7	1.7	1.6	-.1	-6.0
AGENCY FOR INTERNATIONAL DEVELOPMENT					
Applied Research	130.2	149.1	189.5	40.4	27.0
Development R&D	78.1	73.6	80.1	6.5	9.0
Basic Research	4.1	2.7	3.9	1.2	44.0
SMITHSONIAN INSTITUTION	54.0	60.7	68.3	7.6	12.0

Table 4 continued

(Budget Authority in Millions of $)

	FY 83 actual	FY 84 current	FY 85 estimate	FY 84 to FY 85 change $	FY 84 to FY 85 change %
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT	$ 18.0	$ 19.0	$ 20.9	$ 2.0	10.0%
DEPARTMENT OF TRANSPORTATION					
Federal Highway Administration					
Highway Safety R&D	10.6	10.1	10.3	.2	2.0
National Highway Traffic Safety Administration					
Research and Analysis	35.5	41.3	46.6	5.3	13.0
Urban Mass Transportation Administration					
Research and Analysis	58.2	54.8	44.8	-10.0	-18.0
Federal Aviation Administration					
Aviation Medicine	1.4	4.7	5.5	.8	17.0
DEPARTMENT OF JUSTICE					
Office of Justice Research					
Research, Evaluation and Statistics	35.7	35.9	38.2	2.3	6.0
NATIONAL ENDOWMENT FOR THE HUMANITIES					
Education	14.5	19.0	16.1	-2.9	-15.3
Fellowships	13.5	14.5	14.0	-.5	-3.7
Research	16.6	18.4	16.5	-1.9	-10.3

Chapter 11

Physics in the FY 1985 Budget

American Physical Society
Robert Park, Barry Silvermetz

In the short time available for this preliminary analysis it is not possible to perform a complete and detailed study of the Presidential Budget. Therefore, we have focused on the agencies that provide the most direct and visible support for physics research, namely the Department of Energy and the National Science Foundation. In addition, along with some highlights of NASA, we have included for the first time figures from both the National Bureau of Standards and Department of Defense. As might be expected, our analysis suffers from the usual uncertainties in identifying which programs should be regarded as "physics."

Nevertheless, the funding requested for physics research has increased and continues to reflect the improved climate for federal investment in basic sciences. Special emphasis continues to be placed on the revitalization of university laboratory instrumentation. Moreover, funds are requested for both the purchase of more advanced computers and increased access to existing computing facilities.

I. Department of Energy

The Department of Energy has requested a 13.7 percent increase in its support of physics through four main programs: High Energy Physics, Nuclear Physics, Magnetic Fusion and Basic Energy Sciences. The latter includes three sub-programs of relevance: Material, Chemical and Nuclear Sciences. Only the Magnetic Fusion request shows an increase below the administration's anticipated FY 85 inflation rate. Some highlights of the DoE request are:

- Allocation of $20M for preliminary R&D on a Superconducting Supercollider (SSC)
- Construction funds to complete TEVATRON II ($12M)

- Continued funding for detectors at Fermilab's TEVATRON I ($12.5M)
- Increase for construction of SLAC Linear Collider ($60.5M requested) to allow for completion in 1986 (total cost $112M); Also $3.3M provided for work on new SLC detector
- Tandem/AGS Heavy Ion Transfer Line (completion 1986) funded at $5.3M; An additional $5M to be diverted from the cancelled CBA
- New Continuous Electron Beam Accelerator Facility ($5M for R&D; $2M for construction) at SURA's new National Electron Accelerator Lab (NEAL)
- No funds provided for a relativistic heavy ion collider facility
- Increased operational funds requested for LAMPF
- Initiation of Advanced Toroid Facility at Oak Ridge National Lab to investigate improvements in confinement ($8M)
- Modest increase provided for research operations on mirror confinement system; MFTF-B project completion delayed to late FY 86
- No second year funds provided for a Vitreous State Lab at Catholic University (total cost $13.9M) or for a National Chemical Research Center at Columbia University (total cost $20M). An initial $5M was provided for each in FY 84.
- Center for Advanced Materials (CAM) at Berkeley (known last year as the National Center for Advanced Materials) provided with $10.7M in construction funds (completion in 1986 at total cost $40M)
- National Synchrotron Light Source at Brookhaven funded at $10M (completion in 1986, total cost $19.7M)
- Kansas State Ion Collision Facility provided with $2M for a significant construction project (completion in 1987)
- Support for University Research Instrumentation Program ($6M)

A. High Energy Physics (HEP)

With increasing anticipation of successfully unifying nature's strong and weak forces, HEP has requested a 16.9 percent increase over FY 84 appropriations. This would permit a 55 percent average utilization for all facilities. Overall, the research operating expenses would rise 8.2 percent while the facility operation funds would increase by 13.1 percent. Emphasis is placed on research and improvements at Fermilab, SLAC and Brookhaven (BNAL). At the request of HEPAP for "the immediate initiation of a multi-TeV high luminosity proton-proton collider project," funds are requested for critical R&D on magnet systems and conceptual design studies for a Superconducting Supercollider (SSC). It is divided among Fermilab ($4M), BNAL ($9M), LBL ($2M) and various universities and industries ($5M).

B. Nuclear Physics

The Nuclear Physics Program provides approximately 80 percent of the federal support of basic nuclear research. The overall increase requested in FY 85 is 15.4 percent. Research and facility operations would rise a more modest 7.9 percent. The greater increase for Medium Energy Nuclear Physics rests in the R&D support for the Continous Electron Beam Accelerator Facility (CEBAF) for SURA and the operation of a new SLAC off-axis injector ($1.4M). The final construction cost for CEBAF is as yet unknown. Accelerator improvement projects at the University of Washington and Yale University would continue. Although the 1983 Long Range Plan of the Nuclear Science Advisory Committee addressed the need for a relativistic heavy ion collider, no funds are as yet provided.

C. Magnetic Fusion

The 2.5 percent requested increase in funds for the Magnetic Fusion program would allow for no more than a steady level of effort. Emphasis has shifted towards the operation, rather than construction, of large facilities. Capital equipment funding has been reduced by 11.6 percent. In support of efforts to achieve breakeven by 1986 in the Tokamak Fusion Test Reactor (TFTR), increased funds are requested for advanced fusion concepts, most notably reverse-field pinch and compact toroids. Combined research and facility operations for TFTR would rise 17.5 percent. An modest increase of 3.5 percent is requested for research operations on mirror confinement systems. Construction would continue on the MFTF-B facility, while TARA enters its first full year of operation. For advanced fusion

computation, funds are proposed for the lease of a Class VII supercomputer.

D. Basic Energy Sciences

1. Nuclear Science

In contrast to the Nuclear Physics Program, this program provides for the maintenance of crucial data for energy research. Of the 32.5 percent increase, nearly half is provided for the Isotope Preparation project. The remaining increase would allow for experiments and development of enhanced capabilities at existing accelerators, including:

- An increase of 17.9 percent in operating funds for the Stanford Synchrotron Radiation Lab
- A request of $8.9M for the Heavy Ion Fusion Accelerator Research Program, nearly double the request in FY 84

2. Material Sciences

The 22.7 percent increase reflects the high ranking given to material science by the Energy Research Advisory Board. Briefly:

- Large increases are requested for the core program's research and facility operating expenses.
- The Advanced Material Research Initiative, begun in FY 84, includes major increases in construction, namely for the Center for Advanced Materials (CAM), the National Synchrotron Light Source (NSLS) and the Stanford Synchrotron Radiation Lab (SSRL).

3. Chemical Sciences (includes atomic physics)

An overall increase of 19.5 percent would provide for improvements in existing facilities. Most of this increase comes from the first-time inclusion in the construction category of General Purpose Equipment for Argonne National Lab and General Plant Projects for various other labs. Included in the budget are:

- Funds for the development of the Atomic Collision Physics Institute at Kansas State University
- Continued 40 percent operational support for NSLS

Department of Energy

High Energy Physics Funding
(dollars in thousands)

	FY 1983	FY 1984	FY 1985	% Change FY85/FY84
Operating Expenses				
Physics Research	$90,278	$99,500	$107,700	8.2%
Facility Operations	145,400	161,000	182,100	13.1
High Energy Technology	90,100	82,000	91,800	11.9
Capital Equipment	47,500	51,500	65,400	26.9
Construction	57,707	86,000	114,000	32.5
Total	$430,985	$480,000	$561,000	16.8%

High Energy Physics Facility Operating Expenses

	FY 1984 Appropriation	FY 1985 Request	% Change FY85/FY84
Facility Operations			
Fermilab	$73,100	$86,000	17.6%
BNAL	34,200	37,800	10.5
SLAC/PEP	48,000	52,900	10.2
LBL	700	700	0.0
Other	5,000	4,000	-20.0
Total	$161,000	$182,100	13.1%

Department of Energy

Nuclear Physics Funding
(dollars in thousands)

	FY 1983	FY 1984	FY 1985	% Change FY85/FY84
Medium Energy Nuclear Physics	$58,548	$65,000	$72,000	10.7%
Heavy Ion Nuclear Physics	39,910	47,000	49,800	5.9
Low Energy Nuclear Physics	12,257	13,000	13,500	3.8
Nuclear Physics	8,150	9,000	9,300	3.3
Capital Equipment	10,410	11,300	13,700	21.2
Construction	7,700	13,700	25,300	84.6
Total	$136,975	$159,000	$183,600	15.4%

Nuclear Physics Construction
(dollars in thousands)

	Start-Compl.	FY 83	FY 84	FY85	TEC
Cont. Elec. Beam Accel. Fac.	1985-	0	0	$2,000	Under Review
Tandem/AGS Heavy Ion Trans. Line	1984-1986	0	$5,000	5,300	$10,300
University Accel. Upgrade Proj. at U. of Wash. and Yale U.	1984-1987	0	8,000	11,000	19,000
Accel. Improvement Proj.	1985-1987	0	0	3,500	3,500
General Plant Projects	1985-1987	0	0	3,500	3,500
Total		0	$13,000	$25,300	

Department of Energy
Magnetic Fusion Program
(dollars in thousands)

	FY 1982	FY 1984	FY 1985	% Change FY85/FY84
Applied Plasma Physics	$77,300	$81,850	$89,363	9.1%
Confinement Systems	202,838	208,700	213,825	2.4
Development and Technology	83,279	86,030	86,700	0.7
Planning and Projects	87,962	89,550	89,100	-0.5
Program Direction	3,930	4,600	4,150	-9.7
Total	$455,309	$470,750	$483,138	2.6%

Applied Plasma Physics
(dollars in thousands)

Advanced Fusion Concepts	$18,876	$20,358	$23,235	14.1%
Fusion Theory	22,404	23,041	24,970	8.3
Experimental Plasma Physics	17,068	17,060	16,860	-1.1
National MFE Computer Network	14,952	16,331	19,398	18.7
Capital Equipment	4,000	5,060	4,900	-3.1
Total	$77,300	$81,850	$89,363	9.1%

Department of Energy
Magnetic Fusion
Confinement Systems
(dollars in thousands)

Toroidal Confinement Systems				
Research Operations	$56,175	$62,365	$61,450	-1.4%
Major Device Fabrication	11,850	14,800	13,930	-5.8
Tokamak Fusion Test Reactor	69,675	66,985	78,720	17.5
Capital Equipment	15,600	15,550	12,000	-22.8
Subtotal	$153,300	$159,700	$166,100	4.0%
Mirror Confinement Systems				
Research Operations	$43,338	$40,809	$42,125	3.2%
Major Device Fabrication	6,000	3,091	0	%-100
Capital Equipment	6,200	5,100	5,600	9.8
Subtotal	$55,538	$49,000	$47,725	-2.6%
Construction	0	0	0	0
Total	$208,838	$208,700	$213,825	2.4%

Department of Energy
Magnetic Fusion
Planning and Projects
(dollars in thousands)

	FY 1983	FY 1984	FY 1985	% Change FY85/FY84
Operating Expenses				
Tokamak Fusion Test Reactor	$19,835	$20,450	$14,000	-31.5%
Mirror Fusion Test Facility B	12,627	24,500	35,800	46.1
Fusion Materials Irrad. Test Facility	3,500	3,750	3,000	-20
Capital Equipment	4,000	4,350	3,800	-12.6
Subtotal	$35,962	$48,700	$52,800	8.4%
Construction				
MFTF-B	40,000	30,000	20,100	-33%
Fusion Materials Test Facility	2,000	0	3,000	+oo
General Plant Projects	6,000	6,500	9,400	44.6
Subtotal	$48,000	$36,500	$32,500	-10.9%
Program Direction	3,930	4,600	4,150	-9.8%
Total	$87,962	$89,550	$89,100	-0.5%

Physics 185

II. National Science Foundation

With a focus on strengthening the nation's long-term research capability, the NSF has requested an increase of 16.1 percent in the FY 85 budget request for the Mathematical and Physical Sciences Division (see Table II-12). Overall, the MPS request is patterned much after last year's budget. Emphasis is placed on providing modern research instrumentation and facilities, including access to large-scale computational facilities. This same thrust is found in the MPS subactivities, including Physics and Materials Research.

A. Physics Subactivity

Funds for the Physics research program are directed to specific subfields including elementary particle, nuclear, atomic, molecular, plasma and gravitational physics. Overall, the program request for FY 85 is $121.8 million, an increase of $15.9 million, or 15 percent above the FY 84 Current Plan. Last year, an increase of 21 percent was approved. The new request would undoubtedly serve to strengthen university physics research.

Elementary Particle Physics--Of the proposed 18.4 percent increase, more than half would be devoted to improving the capabilities of the Cornell Electron Storage Ring. Support for graduate students and young investigators would rise.

Intermediate Energy Nuclear Physics--The requested increase is 12.6 percent. This includes a substantial increase in support for graduate students and postdoctoral assistants that use the national accelerator facilities. For the third year, funds are provided for construction of the "cooler" ring at the Indiana University Cyclotron Facility. Increased funds are requested for R&D on a high energy microtron for the University of Illinois' nuclear physics research program.

Nuclear Physics--With a 10.3 percent increase, emphasis is placed on revitalizing university accelerator laboratories so as to attract more graduate students and postdoctoral associates (+$2.2 million). The Michigan State University (MSU) Phase II construction project would continue as planned, while operational and instrument support for the lower energy MSU Phase I would be increased.

Atomic and Molecular Physics--The 10.6 percent rise would provide for additional postdoctoral positions and graduate students and allow for more research grants.

Theoretical Physics--The healthy 29.5 percent increase would provide for increased support for both the bar and laser gravitational radiation detector prototypes. Funds for greater use of supercomputers would be increased.

B. Materials Research Subactivity (MRS)

Though not entirely physics, the research projects supported by the various programs in MRS are complementary. The requested increase of 15.9 percent would provide for greater support of large scale scientific computing. Also the number of multi-investigator, interdisciplinary research projects at non-MRL institutions would be increased. Incidentally, NSF provides nearly half of federal support for the basic materials research conducted at universities. Briefly:

- An increase of $8.9 million, or 16.5 percent, is requested for Science Research Project Support (SRPS). Grant sizes within the SRPS be would increased as would the number of principal investigators.

- A substantial 20.2 percent increase for the Instrumentation for Material Research project would bring the total to $7.8 million, almost double the amount provided in 1983.

- The 13.5 percent increase (+$3.5 million) in Materials Research Laboratories would provide for the strengthening of basic engineering research.

National Science Foundation FY 1985 Physics Research and Development Budget
in the Mathematical and Physical Sciences Program

	FY 1983 (Actual)	FY 1984 (Current Plan)	FY 1985 (Estimate)	Actual % Change FY85/FY84
	(in millions of dollars)			
Physics				
Elementary Particle Physics	$28.7	$35.9	$42.5	18.4%
Intermediate Energy Nuclear Physics	13.9	17.0	19.2	12.6
Nuclear Physics	20.5	22.5	24.8	10.3
Atomic, Molecular and Plasma Physics	10.6	12.3	13.6	10.6
Theoretical Physics	10.5	12.1	13.8	14.0
Gravitational Physics	4.9	6.1	7.9	29.5
TOTAL	$89.1	$105.9	$121.8	15.0%
Materials Research				
Solid State Physics	$9.0	$10.6	$12.2	15.3%
Solid State Chemistry	6.5	7.7	9.0	17.2
Low Temperature Physics	6.2	7.3	8.2	12.3
Condensed Matter Physics	6.6	7.6	8.9	16.8
Metallurgy	7.8	9.0	10.3	14.6
Ceramics and Electronic Materials	4.6	5.6	6.9	23.8
Polymers	5.5	6.4	7.7	18.7
Instrumentation for Materials Research	23.4	26.5	30.1	13.5
National Facilities	7.5	10.5	12.1	15.8
TOTAL	$ 81.1	$97.5	$113.0	15.9%

III. NASA

Basic physics research within NASA is scattered among the various missions described within the Astronomy budget analysis. The Office of Space Science and Applications (OSSA) funds a large portion of this research. Unfortunately, there is no clear division between physics research and other fields of study (see NASA Budget Tables). Such a breakdown would require an intimate knowledge of the NASA budget process.

Overall, the OSSA request amounts to a 20.9 percent increase. However, the Research and Analysis figures, which include the parts of the budget that directly support basic research programs in universities and national laboratories, do not reflect the overall increase in OSSA. Briefly:

- The Physics and Astronomy program request in OSSA is up 19.3 percent, but the subprogram of Research and Analysis would rise a modest 3.1 percent.
- Space physics research and analysis under the Environmental Observation subprogram would receive no increase over FY 84 funding.
- Research analysis for the Materials Processing in Space program would rise a modest 6.4 percent to $11.7M.
- In Planetary Exploration, the research and analysis request of $54.5M is 8.4 percent below that provided in FY 84.

One project that warrants open eyes in the physics community is Gravity Probe B. Currently funded at $1.7M out of the Advanced Technology Development portion of Research and Analysis, the proposed funding in FY 85 is close to $5 million (for engineering demonstration). The probe, designed to test the validity of one last prediction of Einstein's General Theory of Relativity (the other four have been verified), could conceivably cost an additional $300 million over a 5-8 year period.

IV. National Bureau of Standards

The NBS has a well-defined mission of providing consistent standards of measurements and references for industry, state and federal laboratories. To help maintain this effort, the the NBS request includes approximately $30.5 million for physics research (including both basic and applied research). This amounts to a $2.0 million, or 7.0 percent increase over last year, according to NBS figures.

- The budget includes $1.5 million to initiate construction of a large cold neutron source for non-destructive testing at the NBS research reactor. Also requested are six new positions. Half of this amount will be devoted to physics. The total expected cost is $30 million.

- Of the $2.5 million increase in Process Quality Control, roughly $1.8 million will be devoted to physics research.

- The zero funding requested for fire research and the proposed reductions in the ADP program would result in a combined $1.5 million loss in physics research from these programs.

Also in the NBS budget:

- A request of $8.9 million for the purchase of a supercomputer. NBS has already saved $8 million for the computer. NOAA will contribute the remaining $3 million.

National Bureau of Standards

	FY 83 (approx.)	FY 84 (approx.)	FY 85 (request)
	(in millions of dollars)		
Physics Research			
Basic	10.6	10.6	9.6
Applied	18.4	17.9	20.9
TOTAL	29.0	28.5	30.5

V. Department of Defense

The Department of Defense supplies figures for DoD-supported basic research (6.1) in the Army, Navy, Air Force and DARPA. Close to half of DoD's basic research is performed by universities. Although the figures are broken down into various disciplines, it is still difficult to clearly extract figures for physics research. Nevertheless, the chart provided does include most of the fields that involve basic physics research.

- Surprisingly, if the figures for the Strategic Defense Initiative (SDI) are excluded, then the FY 85 request is a modest 5.6 percent above the FY 84 total. The increase from FY 83 to FY 84 was 5.9 percent.

- On the other hand, when SDI is included, there is a 12.6 percent increase over last year's funding for physics-related basic research.

- When considered alone, General Physics is slated for an increase of 7.9 percent.

- The material science division shows a 5.7 percent increase.

- The University Research Instrumentation Program, entering the third of a planned five years, would receive $30 million, divided evenly among the Army, Navy and Air Force.

- Apparently, more than half of the SDI funds for DARPA have come from the electronics discipline.

Department of Defense
Physics-Related Basic (6.1) Research

	FY 1983 (actual)	FY 1984 (appro.)	FY 1985 (request)
	(in millions of dollars)		
Army			
General Physics	19.0	19.1	22.1
Materials	17.0	17.1	18.1
Electronics	22.9	22.6	27.5
Atmospheric Sciences	5.8	7.8	9.1
Univ. Research Instrumentation	10.0	10.0	10.0
Independent Army Lab. Research	21.9	21.9	24.5
Navy			
General Physics	33.7	34.9	38.3
Radiation	2.6	3.5	3.9
Astronomy & Astrophysics	4.0	4.3	4.7
Materials	23.7	25.0	27.5
Electronics	27.9	29.1	32.0
Atmospheric Sciences	6.4	6.7	7.4
Univ. Research Instrumentation	10.0	10.0	10.0
Independent Navy Lab. Research	23.0	23.4	25.7
(In addition, the Navy request includes $6.1 million for Strategic Defense Initiatives.)			
Air Force			
General Physics	14.7	19.7	20.3
Astronomy & Astrophysics	5.5	5.7	7.3
Materials	19.1	21.9	22.7
Electronics	15.0	21.0	21.7
Atmospheric Sciences	9.7	10.5	11.2
Univ. Research Instrumentation	10.0	10.0	10.0
Indep. Air Force Lab. Research	13.0	13.1	16.8
Defense Advanced Research Projects Agency (DARPA)			
Materials	22.3	18.8	19.2
Electronics	23.0	25.2	12.5
(In addition, $20.8 million is requested for the Strategic Defense Initiatives.)			
GRAND TOTAL	360.2	381.3	402.5
... plus Strategic Defense Initiative.....			429.4

Chapter 12

Astronomy in the FY 1985 Budget

American Astronomical Society
Peter B. Boyce

I. Highlights of the Astronomy Budget

Support for both ground-based and space-based astronomy missions and major projects continues to be good. The Very Long Baseline Array (VLBA) radio telescope and the Mars Geoscience/Climatological Orbiter (MGCO) planetary exploration mission will be started.

NASA support for individual scientists and research groups, as measured by the level of funding for Research and Analysis, again shows a substantial drop.

Funds for planning the next major space missions, Advanced X-Ray Astronomy Facility (AXAF) and the Shuttle Infrared Telescope Facility (SIRTF), are inadequate.

The Solar Optical Telescope project, started two years ago, remains stalled.

On the positive side, the Mission Operations and Data Analysis line item has been increased. This is the money needed to operate the missions for extended lifetimes and to extract the scientific results from space mission data.

II. Introduction

The report by the National Academy of Sciences Astronomy Survey Committee, Astronomy and Astrophysics for the 1980's, continues to play a major role in shaping the federal budget for astronomy. The report, sometimes known as the "Field Committee Report", outlined a prioritized list of facilities and programs needed to maintain the strength and vitality of U.S. astronomy. The VLBA project, highest ranked of ground based astronomy projects, will start construction in FY1985.

As in previous years, we will limit our analysis of the astronomy budget to the two agencies which provide over 90 percent of the federal funding for astronomical research, NASA and NSF. Other agencies, such as the Smithsonian Institution, the Department of Defense, the Department of Energy, etc. also fund research of interest to astronomy, but they play a minor role in the overall picture of federal support for astronomy.

III. Astronomy in the NASA Budget

Astronomical research in NASA is concentrated in the Divisions of Physics and Astronomy and Planetary Exploration which are in the Office of Space Sciences and Applications. Both divisions have major grant programs which provide support to individuals and groups for research needed to interpret spacecraft observations and for the development of new instruments and technologies required for future missions.

The NASA budget tables are given elsewhere in this volume. The details of the research budgets are given under the heading "Conduct of R&D: Research and Development". The following NASA budget lines may need explanation:

Shuttle/Spacelab Payload Development provides support for building and operating scientific experiments on the Space Shuttle. This line item was supposed to provide relatively low cost and easy access to space experiments by small research groups. Delays in the shuttle development and unforseen complications in mating experiments to the shuttle have forced a major delay in smaller scale space astronomy experiments.

Mission Operations and Data Analysis supports the operating costs of current missions and funds the analysis of data from current and past missions. The whole scientific output of a mission comes from these funds. The very long duration of the facility type missions now being planned increases the importance of this line item.

Research and Analysis supports general research relevant to NASA's missions and provides the advanced technology development needed to plan future missions.

Suborbital Programs supports the flights of aircraft, balloons and rockets. These vehicles provide low-cost platforms for developing instrumentation and provide frequent opportunities for making vital supporting observations.

There are both positive and negative aspects to the NASA budget for FY1985. On the positive side:

Space Telescope, despite schedule and budget slips which occurred last year, remains fully funded. The major technical and managerial problems which surfaced last year seem to have been solved.

The Mars Geochemical/Climatological Orbiter (MG/CO), first of a series of recommended Planetary Explorer missions is funded for a new start.

Galileo, Gamma Ray Observatory and the Venus Radar Mapper missions are fully funded.

The MO&DA budget line shows a large increment for analysis of data from the IRAS and HEAO satellites and from the soon-to-be-repaired Solar Maximum Mission. There is also a large increase to prepare for Space Telescope data handling. This attention to the analysis of scientific data seems to represent an increased commitment on the part of NASA to fully utilize the scientific returns of its missions. Such a step is particularly important in light of the long duration missions now being planned.

The negative aspects of the NASA budget are most apparent as a lack of support for the individual researcher, and a lack of the development money needed for planning future missions. The NASA budget has been discussed extensively by the Space Science Working Group. For particular areas below, I give their estimates of the funds necessary to maintain progress.

The only major approved mission to suffer in the FY1985 budget is the Solar Optical Telescope. It was started two years ago and was stopped last year when the Space Telescope ran into trouble. For FY1985 it continues to be funded at a very constrained level that will prevent initiation of construction. An additional $12M would be needed to start construction this year.

R & A in Planetary Exploration shows a 15 percent drop from FY1984. An additional $10M is needed to maintain the strength of this field.

R & A in Physics and Astronomy lacks sufficient funds to support planning for the next major missions, AXAF and SIRTF. In addition, a planned program in supporting theoretical research apparently will not be funded. It would take an additional $10M in advanced planning money to keep AXAF and SIRTF progressing and $3M to begin a viable program of theoretical research.

Despite the new start for MG/CO, the Planetary Explorer program was not included as a continuing line item as recommended by NASA's own Solar System Exploration Committee.

Finally, despite a strong recommendation from NASA's Committee on NASA-University Relations, there is no increment in this year's budget for upgrading instrumentation in the research laboratories of NASA grantees. The Committee Report suggested an augmentation of $11M distributed over all the NASA program areas.

IV. Astronomy in the NSF Budget

Within the National Science Foundation most astronomical research is supported within the Division of Astronomical Sciences; we limit our analysis to that area since that is the only place where astronomy is specifically enumerated. However, some astronomy is also supported in the Division of Physical Sciences and the Division of Atmospheric Sciences.

The National Science Foundation funds the major share of ground-based astronomical research in the U.S. Through contractors, it operates three National Observatories which are available to qualified scientists under an extensive visitor use program. The National Observatories have major telescopes, which are among the best in the world, as well as smaller telescopes which are used in support of the large ones.

Under Astronomy Research Support, NSF has a large program of peer reviewed research grants to individual investigators and to research groups located at universities and other research observatories.

This year, the NSF has combined its three optical observatories into one entity, the National Optical Astronomy Observatory. By making this change, they expect to achieve a savings in management costs.

The NSF FY1985 budget table for astronomy is given below. The significant aspects are as follows:

Construction of the Very Long Baseline Array will begin with a $15M increment to the budget. This is a four year project being carried out by the National Radio Astronomy Observatory. The VLBA is the highest priority ground-based instrument listed in the Field Committee Report.

While not called out specifically, the National Optical Astronomy Observatory will have $2.9M in FY1985 for development of new telescope technology. This study money is one of the high priority items in the Field Committee Report.

The other astronomy programs show a 3 percent increase, just about level with inflation. Within the Astronomy Research Section, there has been some reorganization and reassignment of grants from the Instrumentation Program to the other programs. Despite the apparent changes, the actual program levels remain nearly unchanged from last year. Specifically, last year's large increase for instrumentation remains in the budget for FY1985.

FY1985 NSF ASTRONOMY BUDGET
(in thousands of dollars)

	FY 1983 Actual	FY 1984 Estimate	FY 1985 Budget
Astronomy Project Support			
Solar System Astronomy	$689.6	$1250.0	$1270.0
Stars & Stellar Evolution	5408.9	6300.0	6490.0
Galactic Astronomy	3734.3	4500.0	5290.0
Extragalactic Astronomy	4908.2	5850.0	7520.0
Instrumentation	6662.9	9700.0	8230.0
Spectrum Management	116.0	100.0	100.0
Total	$21519.8	$27700.0	$28900.0
National Observatories			
Nat. Astron & Ionosph. Cen.	$5110.0	$6200.0	$6300.0
Nat. Optical Astron. Obs.	20189.0	23650.0	24800.0
Nat. Radio Astron. Obs.	15900.0	20600.0	33400.0
VLBA Construction	-.-	(2500.0)	(15000.0)
Total National Obs.	$41199.0	$50450.0	$64500.0
Total NSF Astronomy (in $ Millions)	$62.7	$78.2	$93.4

Chapter 13

Chemistry in the FY 1985 Budget

American Chemical Society
Le-Nhung McLeland, Annette T. Rosenblum

Chemistry draws a broad base of support across federal agencies. The work sponsored falls into two general categories: fundamental basic research aimed at advancing knowledge; and applied research, or even routine application of known principles and methodology, to assist agencies in carrying out their missions. The outlook in the proposed budget for FY 1985 is favorable for basic research in chemistry, in particular research conducted at academic institutions. Proposed funding of applied research in chemistry varies across agencies, showing a mix of increases, level funding, and decreases.[1]

Highlights of FY 1985 Budget

The following seven agencies are the largest federal sources of support for research in chemistry. They account for approximately 95% of the total federal support for chemistry.[2]

- All NSF programs supporting chemistry are slated for a 14.2 percent increase over the FY 1984 level.

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1 The extent to which agency programs are analyzed in this chapter depends upon the level of detail found in the agencies' budget justification books. An attempt was made to separate the chemistry component of research programs from the chemical engineering components. However, such separation could not be done for all programs.

2 National Science Foundation, Federal Funds for Research and Development, Vol. XXXII.

- DOD funding of basic research in chemistry is expected to increase 6.9 percent over last year.

- At DOE, basic research in chemistry is slated for an increase of 7.7 percent. However, overall DOE support for programs involving chemistry is expected to decrease by 4.8 percent.

- The estimated 1 to 2 percent increase in chemical research at NIH is not likely to offset inflation.

- Due to the proposed boost for acid rain research, funding for EPA programs which support chemistry is expected to increase by 20 percent.

- The proposed increase of 3.6 percent in USDA programs supporting chemistry will probably result in a decrease in real level of effort.

- Funding for the NBS programs which traditionally support chemical research is expected to increase 25.8 percent over the FY 1984 level.

National Science Foundation

The total proposed budget for all NSF programs which support research in chemistry is 14.2 percent above the FY 1984 level.

- The main program, CHEMISTRY, is slated for a 15.1 percent increase which is fairly evenly distributed among subfields of chemistry. Included is an increase of $2.6 million in FY 1985 for multi-investigator research activities on the chemistry of life processes, as recently recommended by a National Research Council panel. In addition, a research emphasis initiated in FY 1984 in electrochemistry and surface science (under the Chemical Analysis program) will be expanded in FY 1985 to a total of $5.4 million.

- The CHEMISTRY program will contribute some funds toward the Foundation's initiative to establish university supercomputer facilities, and associated networks and facilities.

- Research instrumentation will be provided through two different modes in the CHEMISTRY program: (1) $9.9 million for individual research projects, and (2) $13.5 million for shared or departmental use. The total of $23.4 million represents an increase of 16 percent over the FY 1984 level.

- If funding for instrumentation is subtracted from the total proposed budget for the CHEMISTRY program, the increase in research support from FY 1984 to FY 1985 is 14.7 percent.

- For the first time in a number of years, the CHEMISTRY Division expects the number of grants awarded to increase from 983 in FY 1984 to 1,032 in FY 1985. In the same period, the average award size is expected to increase from $81,384 to $89,234.

- Among other NSF programs which support chemistry, MATERIALS RESEARCH is the most important. It funds research projects on Polymers and Solid State Chemistry. In addition, it supports interdisciplinary research laboratories and national facilities. All subprograms under MATERIALS RESEARCH which support chemistry are slated for a 15.8 percent increase.

Department of Defense

The Department of Defense plans to continue its stated policy of improving the research capability of universities by providing for growth in funding of basic research and for upgrading of research instrumentation at universities. For the second consecutive year, the proposed increase in DOD funding of basic research (known as the "6.1" budget category) is relatively small compared to the very large percentage increase in defense R&D. Funding for chemistry reflects this overall trend.

- The proposed budget for FY 1985 includes a relatively small 6.9% increase for support of basic research in Chemistry, in contrast to the 26.8% increase in total R&D support. Basic research in Materials would increase by 5.7% over FY 1984. By all accounts the above numbers may be somewhat "soft". They are estimates which have been revised often in the past. In addition, there is a growing perception among the chemical research community that research supported under the DOD "6.1" budget category is not exactly equivalent to basic research, but may include applied research and development.

Table 1. Programs Supporting Chemistry at National Science Foundation
($ thousand)

	FY 1983 Actual	FY 1984 Estimate	FY 1985 Request	% Change FY 1984 - FY 85
FUNDED BY CHEMISTRY DIVISION				
Structural & Thermodynamics	$ 12,952	$ 13,650	$ 15,470	+13.3%
Chemical Physics	10,653	13,110	14,780	+12.7
Chemical Dynamics	13,606	14,460	16,950	+17.2
Chemical Analysis	7,138	7,860	9,120	+16.0
Synthetic Inorganic & Organometallic	7,083	7,860	9,120	+16.0
Synthetic Organic & Natural Products	8,352	9,730	11,310	+16.2
Chemical Instrumentation	7,844	11,630	13,500	+16.1
Subtotal, Chemistry Division	$ 67,628	$ 80,000	$ 92,090	+15.1%
FUNDED BY MATERIALS RESEARCH DIVISION				
Solid State Chemistry	$ 6,480	$ 7,670	$ 8,990	+17.2%
Polymers	5,489	6,380	7,570	+18.7
Instrumentation for Materials Research	3,993	6,470	7,780	+20.2
Materials Research Labs	23,428	26,503	30,09	+13.5
National Facilities	7,540	10,460	12,110	+15.8
Subtotal, Materials Research	$ 46,930	$ 57,483	$ 66,540	+15.8%

Table 1, continued.

	FY 1983 Actual	FY 1984 Estimate	FY 1985 Request	% Change FY 1984 - FY 85
OTHER PROGRAMS INVOLVING CHEMISTRY				
Biochemistry	$ 11,382	$ 12,850	$ 14,650	+14.0%
Atmospheric Chemistry	5,592	6,700	7,250	+ 8.2
NCAR Chemistry	2,114	2,363	2,386	+ 1.0
Volcanology & Mantle Geochemistry	2,602	3,600	3,900	+ 8.3
Experimental & Theoretical Geochemistry	4,924	5,700	6,100	+ 7.0
Marine Chemistry	10,798	12,000	13,400	+11.7
Subtotal, Other Chemistry	$ 37,412	$ 43,213	$ 47,686	+10.4%
TOTAL, ALL PROGRAMS INVOLVING CHEMISTRY	$151,970	$180,696	$206,316	+14.2%

Source: National Science Foundation

TABLE 2. Support of Basic Research in Chemistry at Department of Defense*
($ million)

	FY 1983 Actual	FY 1984 Estimate	FY 1985 Request	% Change FY 1984 - FY 85
CHEMISTRY				
Army	$23.8	$23.5	$25.4	+ 8.1%
Navy	18.2	19.0	20.9	+10.0
Air Force	16.9	19.5	20.0	+ 2.6
TOTAL	$58.9	$62.0	$66.3	+ 6.9%
MATERIALS				
Army	$17.0	$17.1	$18.1	+ 5.8%
Navy	24.0	25.0	27.5	+10.0
Air Force	17.7	21.9	22.7	+ 3.7
DARPA	22.3	18.8	19.2	+ 2.1
TOTAL	$81.0	$82.8	$87.5	+ 5.7%

* Consists of funds classified under budget category "6.1".

Source: Department of Defense, Office of the Undersecretary of Defense for Research and Engineering.

- Other DOD programs support applied research in chemistry. Two areas of emphasis which involve considerable work in chemistry are: development of advanced composite materials, and chemical defense. The present focus in chemical defense is on the development of protective equipment and warning systems, and the development of technologies for disposing of obsolete or leaking munitions in the stockpile.

Department of Energy

Overall funding in the Department of Energy for programs involving chemistry is expected to be 4.8 percent below the FY 1984 level. Programs under Basic Energy Sciences (BES) which support chemistry are slated for a 7.7 percent increase. In contrast, cuts proposed in three technology programs (Solar and Other Renewables, Fossil, and Energy Storage) will reduce funding for activities involving chemistry by 12.0 percent.

Chemical Sciences Program

- A proposed 7.2 percent increase over FY 1984 in operating expenses for this program will provide for:

  - Cost-of-living increases in atomic physics related to fusion, combustion chemistry, heterogeneous catalysis, photochemistry, and supercritical properties of mixtures;

  - Support at approximately the FY 1984 dollar level for projects in analytical research, chemical engineering, coal chemistry, molecular beam research, and radiation chemistry; and

  - Operations and research at the National Synchrotron Light Source at Brookhaven and the Combustion Research Facility at Sandia-Livermore. The Chemical Sciences program is expected to pick up 40 percent ($5.7 million) of the cost of operating the Synchrotron Light Source in 1985. Another $6.0 million will go toward operations and research at the Combustion Facility.

- Most of the 144 percent increase for capital equipment and construction under this program does not appear to benefit chemical research. The major share of this increase is for general purpose equipment ($2.0 million) and general plant projects ($5.0 million) at Argonne National Laboratory. These responsibilities

were transferred from the Nuclear Energy program. In addition, a construction project proposed for the Ion Collision Physics Facility at Kansas State University accounts for $2.0 million in the FY 1985 budget for Chemical Sciences.

Other Programs

- In FY 1985, an increase of 10.5 percent is proposed in operating funds for Materials Chemistry. Construction will continue on two facilities at Lawrence Berkeley Laboratories: a Surface Science and Catalysis Laboratory and an Advanced Materials Laboratory. These facilities are part of the Center for Advanced Materials (CAM). For programmatic research associated with the CAM project, $2.9 million is requested. This research will emphasize: processing of polymers, new catalytic materials, and structural ceramics; utilization of surface instrumentation; and investigation of the properties and behavior of electronic materials such as gallium arsenide.

- The Environmental Fate and Behavior program is expected to provide $5.0 million for a new study on the linearity of the processes by which SO_2 and NO_x are converted to acidic materials in clouds and precipitation.

Instrumentation

The following department-wide programs are expected to benefit chemistry research.

- DOE is continuing its University Research Instrumentation initiative with a request of $6.0 million to enable 10-20 university research groups to purchase instrumentation costing in excess of $100,000. In addition, the Department will continue to fund university instrumentation through its research programs. A rough estimate is that 10 percent ($34.3 million in FY 1985) of the DOE R&D funds going to universities will be used to purchase instruments at individual costs of $35,000 or less.

- $7.0 million is requested to expand advanced computing activities on the Magnetic Fusion Energy Computer Network for researchers supported by DOE.

TABLE 3. Programs Supporting Chemistry at Department of Energy ($ thousand)

	FY 1983 Actual	FY 1984 Estimate	FY 1985 Request	% Change FY 1984 - FY 85
Basic Energy Sciences				
Materials Chemistry	$ 12,300	$ 13,380	$ 14,790*	+10.5%
Chemical Sciences	70,000	75,500	80,930	+ 7.2
Nuclear Science - Heavy Element Chemistry	4,406	4,691	5,125	+ 9.3
Geochemistry	3,942	3,352	3,610*	+ 7.7
University Research Support				
University Lab Coop. Research	4,284	3,500	6,550	+87.1
Biological and Environment Research				
Source and Dose Determination	10,275	10,161	10,300	+ 1.4
Environmental Fate and Behavior	29,498	28,267	32,726	+15.8
Solar and Other Renewables**	139,009	130,500	122,285	- 6.3
Energy Storage	25,100	25,700	16,603	-35.4
Coal***	195,150	185,140	156,642	-15.4
Petroleum	23,750	30,300	31,600	+ 4.3
Industrial Energy Conservation				
Waste Energy Reduction	11,963	12,000	12,350	+ 2.9
Industrial Process Efficiency	7,700	14,200	8,000	-43.7
Multi-Sector Energy Conservation				
Energy Conversion and Utilization Technologies	9,000	9,000	17,850	+98.3
TOTAL, ALL PROGRAMS INVOLVING CHEMISTRY - OPERATING EXPENSES	$546,377	$545,691	$519,361	- 4.8%

* Estimate. ** Excludes Wind, Ocean, International, Technology Transfer, Geothermal, and Hydropower programs. *** Excludes Heat Engines and Fuel Cells programs.
Source: Department of Energy

Table 4. Chemical Sciences - Department of Energy
($ thousand)

	FY 1983 Actual	FY 1984 Estimate	FY 1985 Request	% Change FY 1984 - FY 85
Fundamental Interactions				
Photo- & Radiation Chemistry	$20,955	$22,515	$24,960	+ 10.9%
Chemical Physics	16,176	17,367	18,464	+ 6.3
Atomic Physics	6,367	6,870	7,240	+ 5.4
Processes and Techniques				
Chemical Energy	13,447	14,441	15,118	+ 4.7
Separations & Analysis	11,221	11,900	12,520	+ 5.2
Chemical Engineering Sciences	1,834	2,407	2,628	+ 9.2
TOTAL, OPERATING EXPENSES	$70,000	$75,500	$80,930	+ 7.2%
CAPITAL EQUIPMENT	$ 5,510	$ 6,520	$ 8,840	+ 35.6%
CONSTRUCTION	$ 400	$ 450	$ 8,050	+168.9%

Source: Department of Energy

National Institutes of Health

The National Institute of General Medical Sciences and the National Cancer Institute are the major sources of funds for extramural chemical research. The total of the proposed FY 1985 budgets for these two institutes is 2.1 percent above the FY 1984 level. Therefore, it is assumed that extramural support for chemistry will increase by 2.1 percent. It can also be inferred from the proposed funding for these two institutes that intramural support for chemistry will probably increase by 1 to 2 percent. (See Chapter on "Health Research in the FY 1985 Budget" for additional information.)

Total funding for the two instrumentation programs at NIH is expected to remain constant at the FY 1984 level of $48.7 million. Of this, $21.0 million is for shared instrumentation, and $27.7 million for biotechnology instrumentation. These programs make research instrumentation available to investigators whose research projects are supported by NIH.

Environmental Protection Agency

It has always been difficult to estimate the amount of chemical research performed under the auspices of EPA. Attesting to that difficulty is the fact that over the last decade the figures reported by EPA for publication in the NSF series, "Federal Funds for Research and Development," show wide fluctuations and obvious shifts associated with redefinitions of "chemical research." This is probably due in part to the inability to separate the following components in many research projects: chemistry, chemical engineering, and environmental sciences.

For this analysis, an attempt was made to identify the research activities which include chemistry, under each of the EPA program categories.

- MONITORING SYSTEMS AND QUALITY ASSURANCE is the category with the highest degree of support for chemistry, in particular for the development of analytical and monitoring methods. Programs under this category which support chemistry are expected to be funded at 13.4 percent above the FY 1984 level. Most of the increase will go toward:

  - Recertification of the purity of chemical standards in the Pesticide Repository;

- Validation of analytical methods for hazardous waste characterization, and validation of instack monitoring methods for determining the effectiveness of incinerators; and

- Development of methods for measuring atmospheric toxic substances (in particular azo dyes), and volatile organic compounds which are currently difficult to isolate.

- ENVIRONMENTAL ENGINEERING AND TECHNOLOGY is mostly engineering with a small amount of chemistry. Programs under this category which support chemistry are slated for a 1.8 percent decrease below the FY 1984 level. This overall decrease results from:

  - Large increases in the Municipal Wastewater Research program, and in research on emission reduction technologies for coal-fired boilers under the Gases and Particles Research program;

  - A large decrease in the Drinking Water Research program due to completion of cooperative research with the water utility industry.

- Research on ENVIRONMENTAL PROCESSES AND EFFECTS combines the disciplines of engineering, biology, and chemistry to study the behavior of pollutants in the environment. Those programs which involve chemistry are slated for a 8.7 percent decrease below the FY 1984 level, reflecting completion of research on gaseous and particulate emissions from heavy-duty diesel trucks and buses.

- The EXPLORATORY RESEARCH program was established at the urging of Congress and the National Academy of Sciences to fund long-term research. In FY 1985, this program is expected to continue to support eight university-based research centers and provide competitive research grants at approximately the FY 1984 funding levels. The overall decrease in funding shown on Table 5 results from the transfer of a minor item to another budget category, offset by an increase in funding for the Visiting Scientists Program to bring scientists to work at EPA laboratories.

TABLE 5. Programs Supporting Chemistry at EPA ($ thousand)

		FY 1983 Actual	FY 1984 Estimate	FY 1985 Request	% Change FY 1984 - FY 85
Monitoring Systems & Quality Assurance:	In-house	$ 14,110.5	$ 12,520.6	$ 14,024.7	+ 12.0%
	Extramural	15,218.4	14,774.5	16,940.5	+ 14.7
Subtotal		$ 29,328.9	$ 27,295.1	$ 30,965.2	+ 13.4
Environmental Engineering & Technology:	In-house	$ 18,927.4	$ 14,152.3	$ 16,240.9	+ 14.8%
	Extramural	37,170.4	34,921.3	33,697.1	- 3.5
Subtotal		$ 56,097.8	$ 49,073.6	$ 49,938.0	+ 1.8
Environmental Processes & Effects:	In-house	$ 1,222.7	$ 1,128.4	$ 992.9	+ 12.0%
	Extramural	1,851.8	946.2	900.2	- 4.9
Subtotal		$ 3,074.5	$ 2,074.6	$ 1,893.1	- 8.7%
Exploratory Research:	In-house	$ 1,595.9	$ 441.3	$ 578.5	+ 31.1%
	Extramural	4,910.2	16,512.3	15,160.0	- 8.2
Subtotal		$ 6,506.1	$16,953.6	$ 15,738.5	- 7.2%
Acid Rain:	In-house	$ 820.4	$ 590.5	$ 952.5	+ 61.3%
	Extramural	12,250.3	14,784.3	33,412.5	+126.0
Subtotal		$ 13,070.7	$ 15,374.8	$ 34,365.0	+123.5%
ALL PROGRAMS INVOLVING CHEMISTRY	In-house	$ 36,676.9	$ 28,833.1	$ 32,789.5	+ 13.7%
	Extramural	71,401.1	81,938.6	100,110.3	+ 22.2
	TOTAL	$108,078.0	$110,771.7	$132,899.8	+ 20.0%

Source: Environmental Protection Agency

- The substantial boost of 123 percent in ACID RAIN research is expected to provide significant new support for research involving chemistry and chemical engineering. In particular, efforts to establish measurement technologies for dry deposition will be increased, and new work in cloud chemistry and fog acidity will begin.

- In summary, funding for EPA programs which support chemical research is expected to increase by approximately $20 million. ACID RAIN research accounts for most all of that overall increase.

Department of Agriculture

The bulk of chemical research supported by USDA is performed in-house in seven major research centers under the Agricultural Research Service. The corresponding budget category, Processing, Storage, and Food Safety is expected to increase by 3.6 percent above the FY 1984 level of $89.6 million. There is no indication of any major reduction or termination of activities under this category. Therefore, it is assumed that all ongoing research activities will continue at the FY 1984 level, or slightly below that level.

National Bureau of Standards

The FY 1985 request for the National Bureau of Standards is $126.1 million, 8.9 percent above the FY 1984 level. It should be noted that NBS also receives reimbursements for R&D performed for other agencies. In FY 1984 and 1985, reimbursements will be equal to approximately half of the total NBS budget.

NBS programs involving chemistry are slated for a decrease of 4.5 percent from the FY 1984 level. This overall decrease is due to the proposed termination of Fire Research and Building Research.

The four programs that traditionally support chemistry will be funded above the FY 1984 levels. The proposed increase is a modest 7.0 percent in two of these programs (Analytical Chemical Measurements & Standards, and Chemical Engineering Metrology). The other two will receive much larger increases to support two initiatives of importance to chemistry:

TABLE 6. Programs Supporting Chemistry at National Bureau of Standards ($ thousand)*

	FY 1983 Actual	FY 1984 Estimate	FY 1985 Request	% Change FY 1984 - FY 85
Measurement Research & Standards (M&S)				
Analytical Chemical M&S	$ 2,383	$ 2,624	$ 2,810	+ 7.1%
Chemical Properties and Processes	3,275	3,631	6,881	+ 89.5
Materials Characterization, Processing & Performance	14,560	14,937	17,758	+ 18.9
Other Programs Supporting Chemistry				
Chemical Engineering Metrology	$ 3,738	$ 4,136	$ 4,424	+ 7.0%
Fire Research	5,976	5,827	0	-100.0
Building Research	4,113	3,174	0	-100.0
Technical Competence Fund	7,145	8,169	8,727	+ 6.8
TOTAL, ALL PROGRAMS INVOLVING CHEMISTRY	$41,190	$42,498	$40,600	- 4.5%

* Figures include special equipment, and overhead.

Source: National Bureau of Standards

- Most of the 89.5 percent increase proposed for Chemical Properties and Processes will be for research and development of techniques for using biotechnology in chemical production and related industries.

- Approximately half of the 18.9 percent increase for Materials Characterization Processing and Performance will be for the development of a prototype cold source and of instruments for cold neutron research on the properties, performance, and processing of materials and chemicals. This represents the beginning of a long-term effort to establish a world-class, national user facility.

In addition, the Technical Competence Fund, budgeted for a 6.8 percent increase over the FY 1984 level, will support some chemical research. This fund was established a number of years ago to build up and maintain scientific and technical expertise in the NBS staff. Another agency-wide initiative will also benefit chemical research. It is the plan to purchase a Class VI Supercomputer for use in NBS and NOAA programs.

Chapter 14

FY 1985 R&D in the Atmospheric and Oceanic Sciences

American Meteorological Society
Fred D. White

As shown in Table 1, atmospheric and oceanic sciences R&D overall are expected to receive a modest increase during FY 1985 with the exception of NOAA. Atmospheric sciences show a 17 percent increase, while oceanic sciences show a 14 percent decrease.

Table 1. R&D in the Atmospheric and Oceanic Sciences (budget authority in millions)

	FY 1983 Actual	FY 1984 Est.	FY 1985 Est.
Atmospheric			
NSF	$ 78.4	$ 92.4	$101.8
NASA	139.9	143.8	201.3
DOD	90.3	94.2	109.2
Commerce (NOAA)	88.7	103.0	94.9
DOE	17.1	21.3	26.0
EPA	19.3	19.6	21.6
Subtotal	$433.7	$474.3	$554.8
Oceanic			
NSF	$105.1	$116.5	$128.0
DOD	65.9	66.1	70.3
NASA	17.0	18.2	19.4
Commerce (NOAA)	133.7	136.1	72.6
Subtotal	$321.7	$336.9	$290.3
TOTAL	$755.4	$811.2	$845.1

Highlights for FY 1985 include:

- NASA has been given the green light by the Administration to forge ahead on the development of a $650-million Upper Atmosphere Research Satellite to investigate the chemical composition of the upper atmosphere. The FY 1985 budget includes $60.7 million for this purpose.

- NSF plans to seek funds to begin the acquisition of an Advanced Vector Computer (AVC) System for NCAR. This computer is expected to have greatly increased central memory and speed compared to the current NCAR mainframe computers. The FY 1985 budget includes $5.0 million for this purpose.

- The Department of the Navy has programmed the start of an operational satellite system--the Navy Remote Ocean Sensing System (NROSS), which is scheduled for launch in late 1988. To go along with this, NASA will seek funds to initiate development of a $125-million Scatterometer to measure ocean surface winds. The NASA FY 1985 budget includes $15 million for this purpose.

National Science Foundation (NSF)

The National Science Foundation's budget for FY 1985 is $1,501.8 million, an increase of $179.8 million, or 13.6 percent, above the FY 1984 level of $1,322.0 million. The atmospheric and oceanic sciences are projected for a 10 percent increase from $208.9 million in FY 1984 to $229.8 million in FY 1985.

Atmospheric Sciences. As one of nine agencies that support research activities in atmospheric sciences, NSF plays a significant but not predominant role in the total federal effort. NSF presently is the largest single supporter of academic research in the atmospheric sciences, providing approximately 50 percent of the federal funding. (See Table 2 for a distribution of NSF's support for atmospheric sciences.)

The four areas that were designated for significant growth in FY 1984 continue to be emphasized in FY 1985. These areas are instrument and research equipment acquisition, mid-latitude storm research, global tropospheric chemistry, and climate studies.

Specific areas that will be emphasized in FY 1985 include:

- In aeronomy, the increase will permit the upgrading

Table 2. R&D in NSF's Atmospheric Sciences Program

	FY 1983	FY 1984	FY 1985
Atmospheric Project Support			
Aeronomy	$ 5.4	$ 6.1	$ 6.6
Atmospheric Chemistry	5.6	6.7	7.2
Climate Dynamics	6.1	7.2	7.8
Experimental Meteorology	3.8	5.2	5.6
Global Atmospheric Research Program (GARP)	5.8	4.8	4.5
Meteorology	7.0	8.4	9.1
Solar Terrestrial Research	6.0	7.1	7.7
Subtotal	$39.7	$45.5	$48.5
National Center for Atmospheric Research	$32.4	$40.0	$45.9
Upper Atmospheric Research Facilities	3.5	3.8	4.1
Arctic Atmospheric Science Research	0.9	1.0	1.1
Antarctic Atmospheric Science Research	1.9	2.1	2.2
TOTAL	$78.4	$92.4	$101.8

and some increase in research equipment used to conduct thermospheric dynamic studies.

- In atmospheric chemistry, development of instrumentation for global tropospheric chemistry studies will continue to be expanded.
- In climate dynamics, research on the impact of radiation/cloud interactions on climate will be expanded.
- In experimental meteorology, the field program on East Coast winter storms will be conducted in FY 1985.
- As part of the continuing phase-down in GARP, more of the support for climate-related modeling will be carried out in the Climate Dynamics Program.
- In meteorology, continued expansion of interactive computing capabilities at universities will be supported.

- In solar terrestrial research, simulation studies of the solar terrestrial system and theoretical research on space plasmas will be expanded.

- At NCAR, the increase will provide for the initial acquisition cost of an Advanced Vector Computer (AVC) and additional mass storage capability.

Oceanic Sciences. NSF currently supports about 50 percent of all federally supported ocean research efforts in the United States and about 70 percent of all academic basic ocean research. In addition, almost 70 percent of funding for the federally funded 25-vessel academic research fleet is provided by NSF. NSF continues to manage the ocean drilling program with foreign cooperation. (See Table 3 for a distribution of NSF's support of Oceanic Sciences.)

Table 3. R&D in NSF's Oceanic Sciences Program

	FY 1983	FY 1984	FY 1985
Physical Oceanography	$ 14.7	$ 15.5	$ 17.2
Marine Chemistry	10.8	12.0	13.4
Submarine Geology and Geophysics	12.6	14.5	16.1
Biological Oceanography	11.8	12.6	14.2
Oceanographic Facilities and Support	31.6	32.8	36.4
Ocean Drilling Program	21.0	26.3	27.6
Arctic Oceanography	1.2	1.2	1.2
Antarctic Oceanography	1.4	1.6	1.9
TOTAL	$105.1	$116.5	$128.0

The increases planned for FY 1985 will support the following:

- Approximately 10 percent of the increase will support continued upgrading of instrumentation capabilities in all areas of ocean sciences.

- Increases in submarine geology and geophysics, marine chemistry, and biological oceanography will support submersible research on the evolution of the oceanic crust, the chemistry of hydrothermal vents, and the microbiology and physiology of vent organisms.

- In oceanographic facilities support, increased funding will support expanded operations of the academic research fleet. Submersible science operations will move into the western Pacific for an estimated full year.

- The Ocean Drilling Program will begin field operations in FY 1985. Four or five countries are expected to participate in this new and revamped drilling program.

Department of Defense (DOD)

Although the overall DOD budget has been increased, support for R&D in the atmospheric and oceanic sciences has shown a smaller rate of increase, as evidenced by the 1983-1984 nearly level funding with decreases in Army and Navy atmospheric sciences funding. Congressional actions have been reducing funding levels in the atmospheric and oceanic sciences by 10-12 percent below requested levels. After Congressional action, the FY 1985 amount will probably be lower. The overall 4 percent increase from FY 1983 to FY 1984 is expected for FY 1984 to FY 1985. There are no new R&D programs proposed for 1985. Two new programs in 1984 were cut by Congress. (See Table 4.)

Table 4. R&D in DOD's Atmospheric and Oceanic Sciences

	FY 1983	FY 1984	FY 1985
Atmospheric Sciences			
Army	$ 19.8	$ 18.9	$ 24.7
Navy	19.1	18.7	25.7
Air Force	51.4	56.6	58.8
Subtotal	$ 90.3	$ 94.2	$109.2
Oceanic Sciences			
Navy	$ 65.9	$ 66.1	$ 70.3
TOTAL	$156.2	$160.3	$179.5

The Army atmospheric sciences programs continue to be motivated by urgent requirements to quantify the effects of natural and battlefield-induced aerosols. Other programs are focused to attack problems on remote atmospheric sensor development, atmospheric effects on high-energy laser research, and tactical weather intelligence. A

hand-held eye-safe LIDAR for visibility and ceiling measurements has been developed for tactical and R&D field use. The apparent FY 1985 increase in research funds is predominantly related to the development of a training system for the Meteorological Data System, which will replace the aging rawinsonde system. An active research support program continues through the Army Research Office. Active field and laboratory programs continue at White Sands.

The Navy has a broad R&D program in the atmospheric and oceanic sciences. The overall objective of the Navy program in atmospheric sciences is to improve environmental prediction capabilities for naval operations. There is an increase in emphasis on air-sea transfer and rapid over-water cyclogenesis in the basic research portion of the program. Considerable effort is being directed toward upgrading the quality, quantity, dissemination, and display of observations over the oceans--the Tactical Environmental Support System (TESS). Ocean dynamics and acoustics continue to be the main thrusts of the oceanic sciences R&D program planned for FY 1985. An operational oceanographic satellite (NROSS) has been proposed for 1985 by the Navy. (See NASA R&D on new Scatterometer for this satellite.)

The Air Force has a vigorous R&D program in the atmospheric sciences primarily managed through the Air Force Geophysics Laboratory. A major focus of the program is the atmospheric transmission of electromagnetic radiation throughout the spectrum and the display of these data for operational use. The Automated Weather Distribution System with joint U.S. and Canadian development is a key program to tie together the Air Force weather support activities. It is an important effort to upgrade the 1950's technology at the local weather stations. The Air Force also participates in the interagency development of NEXRAD (the next-generation Doppler weather radar being developed to replace the existing 20-year-old weather radars).

National Aeronautics and Space Administration (NASA)

NASA's overall budget (including operational programs as well as R&D) is projected to increase from $7,217.5 million in FY 1984 to $7,491.4 million in FY 1985. This represents about a 4 percent increase. This modest increase includes a commitment for the initiation of the development of a manned Space Station that will be designed and built over the next decade.

Nearly all of NASA's support for R&D in the atmospheric and oceanic sciences is included in the budget for the Environmental Observations Program of the Office of Space Science and Applications (see Table 5). Note that the total for atmospheric and oceanic sciences is proposed for a 36 percent increase, from $162.0 million in FY 1984 to $220.7 million in FY 1985.

Table 5. R&D in NASA's Atmospheric and Oceanic Sciences (R&A denotes Research and Analysis)

	FY 1983	FY 1984	FY 1985
Upper Atmosphere R&A	$ 27.7	$ 28.5	$ 31.0
Atmospheric Dynamics and Radiation R&A	26.5	27.5	28.5
Space Physics R&A	15.2	16.7	16.7
Shuttle/Spacelab Payload Development	3.7	7.6	7.8
Operational Satellite Improvement Program	6.0	0.6	--
Earth Radiation Budget Experiment	24.0	15.5	8.1
Extended Mission Operations	22.8	27.4	29.5
Interdisciplinary R&A	--	--	1.0
Tethered Satellite Payloads	--	--	3.0
Scatterometer	--	--	15.0
Upper Atmosphere Research Satellite Mission	14.0	20.0	60.7
Subtotal	$139.9	$143.8	$201.3
Oceanic Processes R&A	$ 17.0	$ 18.2	$ 19.4
TOTAL	$156.9	$162.0	$220.7

In FY 1985, these are the highlights of the NASA program in atmospheric and oceanic sciences:

- Initiation of the development of a Scatterometer that will provide accurate, global measurements of ocean surface winds useful for both oceanography and meteorology. This Scatterometer is required for the Navy Remote Ocean Sensing System (NROSS) scheduled for launch in late 1988.

- A major increase in funds for continued development of instruments for the Upper Atmosphere Research

Satellite (UARS), which is the next logical step in conducting a comprehensive program of research, technology development and monitoring of the upper atmosphere.

- Continuation of suborbital investigations program. Particular emphasis will be placed on the analysis of data from the International Cometary Explorer Satellite. Definition studies will be continued on the International Solar-Terrestrial Physics Mission and on Shuttle/Spacelab missions such as the DOD Combined Chemical Release and Radiation Effects Satellite (CRRES).

- Continued support for the Measurement of Air Pollution from Satellites (MAPS) activities, including data reduction, refurbishment for reflight and upgrading of the ground service equipment, and a new data recorder. During FY 1985, preliminary definition and breadboard laboratory activities will be conducted on the Light Detection and Ranging (LIDAR) instrumentation.

- Continuation of work on the Earth Radiation Budget Experiment (ERBE), which will measure the temporal and spatial variations in the Earth's radiation budget to gain basic insight into the causes for climatic fluctuations. Development of ERBE instruments are complete, and the launching of the Earth Radiation Budget Satellite (ERBS) from the Shuttle is expected in 1984. The sensors will also be incorporated on NOAA-F and NOAA-G satellites.

- Initiation of the design and development of scientific instruments for the first test flight of the Tethered Satellite System (TSS), which is scheduled for launch in 1987. The System will provide a new facility for conducting experiments weighing 500 kg or less from distances of 100 km above or below the Space Shuttle.

- Continuation of upper atmospheric research and analysis, including research on stratospheric and tropospheric air quality. The intercomparison of balloon, aircraft, and ground-based measurements will be continued to ensure the validity of the different techniques that have been developed and to observe chemical species in the stratosphere and troposphere to determine the exchange of gases between the lower and upper atmosphere.

- Continuation of activities within the Atmospheric Dynamics and Radiation Program in the areas of global-scale processes research, mesoscale processes research, and climate research.

National Oceanic and Atmospheric Administration (NOAA)

For the fourth year in a row, the Reagan Administration has seriously limited NOAA's budget request. For FY 1985, NOAA was permitted to ask for only $899.3 million, down approximately 10 percent from the $993.5 million appropriated by Congress for FY 1984. As shown in Table 6, R&D in NOAA received even harsher treatment. The overall total for both atmospheric and oceanic sciences shows a major 30 percent decrease of some $71.6 million from the $239.1 million appropriated by Congress in FY 1984 to the $167.5 million being requested in the FY 1985 budget.

Table 6. Estimated R&D in NOAA's FY 1985 Budget

	FY 1983	FY 1984	FY 1985
Ocean and Coastal Programs	$62.2	$64.6	$34.0
Marine Fishery Resources Programs	47.4	46.9	27.5
Atmospheric Programs	63.1	78.8	74.1
Satellite and Environmental Data and Information Services	9.6	9.6	9.6
Program Support	32.1	29.2	22.3
S/K Appropriation	8.0	10.0	--
TOTAL	$222.4	$239.1	$167.5
Estimated Subtotals			
Atmospheric Sciences	$ 88.7	$103.0	$94.9
Oceanic Sciences	$133.7	$136.1	$72.6

For FY 1985, the projected R&D decreases are very illuminating. Space limitations will allow only a few key reductions to be noted:

- In atmospheric sciences R&D, NOAA proposes to: eliminate all weather modification research; reduce support for the completion of GARP analysis; reduce support for the Ocean-Atmospheric Climatic Interaction Studies (OACIS), which were just initiated last year; reduce support for acid rain research;

cut back Prototype Regional Observation and Forecast Service (PROFS) R&D; eliminate research at the Solar Environmental Laboratory; and terminate the FY 1982 climate data base initiative.

- In oceanic sciences, NOAA proposes: termination of the Sea Grants Program; elimination of the Coastal Zone Management Program; termination of the Undersea Research Program; termination of the Great Lakes Research Program; termination of the Regional Ocean Pollution Program; substitution of chartering for Fisheries Research Fleet; laying up two research vessels and cutting back days at sea for others; elimination of S/K grants; and termination of aquaculture R&D. As can be noted in Table 6, oceanic sciences R&D received the major share of the reductions.

It is very hard to draw a line in NOAA as to what belongs in R&D and what belongs in operations. Much of NOAA's operations are extremely relevant to the R&D program of some other federal agency. Here are some other reductions planned by NOAA: eliminate the congressionally mandated National Advisory Committee on Oceans and Atmosphere (NACOA); cut back to one polar orbiting satellite; reduce data buoy activities; reduce regional hydrologists; terminate agriculture weather services; reduce fire weather services; terminate the fruit frost program; reduce NOAA weather wire; and reduce NOAA's overall employment by 1,089. For three years Congress has restored the majority of the harsh cuts proposed by the Administration for NOAA. Hopefully, Congress will exercise similar judgment in reviewing NOAA's 1985 budget request.

Department of Energy (DOE)

The major portion of DOE's research in atmospheric sciences is carried out in the Office of Energy Research, which is the parent office of the Office of Health and Environmental Research and the Office of Basic Energy Sciences.

	FY 1983	FY 1984	FY 1985
DOE	$17.1	$21.3	$26.0

In the Office of Health and Environmental Research are the programs in long-range transport and dispersion--the Cross Appalachian Transport Experiment (CAPTEX); the

Atmospheric Study of Complex Terrain (ASCOT); the Acid Rain Program, including the new Non-Linearity Study; the High-Altitude Sampling Program (HASP); and Energy and Climate Interactions. The latter two studies are due for sharp reductions. The carbon dioxide research and work in the upper atmosphere are in the Office of Basic Energy Sciences.

Smaller amounts of atmospheric research are carried out by the Solar Energy Research Institute, the Federal Energy Regulatory Commission, and several other DOE groups. DOE-supported atmospheric research is performed by the DOE national laboratories, universities, private groups, and other government agencies under contract to DOE.

Environmental Protection Agency (EPA)

Atmospheric sciences R&D in EPA is projected to remain relatively constant.

	FY 1983	FY 1984	FY 1985
EPA	$19.3	$19.6	$21.6

EPA's atmospheric sciences program includes research in broad areas of atmospheric processes research that include acid deposition, gases and particles, oxidants, and hazardous air pollutants. The principal focus of the atmospheric process research program is the development of air quality simulation models for use in developing and evaluating State Implementation Plans for controlling atmospheric levels of criteria pollutants. In FY 1985, research will focus on model evaluation and improvement, where improvements will focus on the development of better chemical mechanisms describing atmospheric pollutant transformations. Within the area of atmospheric processes, research on acid rain will receive the major emphasis, while the other areas will be slightly reduced.

Other Agencies

Other agencies supporting R&D in the atmospheric sciences are: the Department of Agriculture and the Department of Transportation (FAA). In the oceanic sciences, other federal support is provided by DOE, DOI, DOT, and EPA. However, the budget figures for FY 1985 were not readily available. It is estimated that approximately 90 percent of the total federal program in the atmospheric and oceanic sciences R&D have been summarized in this report.

Interagency Programs

There are many interagency programs in the atmospheric and oceanic sciences, including GARP, the National Climate Program, the Tropical Ocean and Global Atmosphere Program (TOGA), Next Generation Weather Radar (NEXRAD), Weather Modification, and the National Acid Precipitation Assessment Program. Let us briefly discuss the last two.

Weather Modification. During FY 1984 two federal agencies supported R&D activities in this area, namely, NOAA and the Bureau of Reclamation (BUREC) of the Department of the Interior. Some NSF grants supported R&D directed toward Weather Modification, but they no longer have a specific Weather Modification Program. FY 1984 appropriations for Weather Modification totaled $7.4 million--$1.5 million for NOAA and $5.9 million for BUREC. For FY 1985, the outlook for Weather Modification R&D looks glum. NOAA is dropping its Weather Modification program altogether, and the BUREC proposed budget calls for a slightly reduced program of $5.5 million. This is a 26 percent reduction for Weather Modification R&D.

The National Acid Precipitation Assessment Program. This interagency program is projected for a 100 percent increase in FY 1985, going from $27.5 million in FY 1984 to $55.5 million in FY 1985. This dramatic increase in funds reflects the increased attention being given by the Administration to this important problem. Table 7 presents a distribution of this program throughout the government.

Table 7. The National Acid Precipitation Assessment Program (FY 1985)

	EPA	USDA	NOAA	DOE	DOI	TOTAL	(%)
Natural Sources	$	$	$0.9	$	$	$ 0.9	1.5
Man-Made Sources	1.2			0.8		2.0	3.5
Atmos. Processes	10.6		1.0	5.3		16.8	30.3
Depos. Monitoring	4.4	0.4	0.5	1.0	2.3	8.5	15.3
Aquatic Effects	9.0	0.2		0.2	1.1	10.5	18.9
Terres. Effects	5.6	3.2		0.1	0.8	9.7	17.5
Eff. on Materials	1.0				1.1	2.1	3.8
Control Tech.	0.6					0.6	1.1
Assessments and Policy Analysis	3.0			1.4		4.4	8.0
TOTAL	$35.4	$3.8	$2.4	$8.7	$5.3	$55.5	
(%)	63.7	6.8	4.3	15.6	9.6		

In addition to the ongoing basic research in FY 1984, the major new initiatives proposed for FY 1985 include the following:

- Major Atmospheric Study. EPA, DOI, and the Electric Power Research Institute are cooperating in planning a large-scale, comprehensive atmospheric field study.

- Wet and Dry Deposition Monitoring. The number of wet deposition monitoring stations will be increased significantly, and the dry deposition methods research and development will be accelerated.

- Liming Studies. A feasibility study on the benefits and limitations of lake liming as a possible mitigation strategy will be initiated in FY 1985.

- Ecological Monitoring Program. The ongoing long-term monitoring program will be expanded to include more intensive ecological monitoring, so that a change can be observed at a more detailed level, thereby increasing the ability to understand the processes as well as the ability to detect change.

- Surveys of Lakes and Streams, and Forests. In FY 1985, the initial planned lake survey will be expanded to include several hundred streams, as well as fisheries in a select number of lakes. Also in FY 1985, a national survey of forest damage and sensitivity will be initiated.

- Field Exposure of Materials. The program on field exposure of materials will be expanded in FY 1985 to address the problem of multiple pollutants attacking construction materials.

- Control Technologies. In FY 1985, the National Program includes funds for analyses of specific control technology issues important to acid deposition.

- Current Damages Assessment. One of the important milestones of the National Program is an assessment of the magnitude of current damages from acid deposition and estimates of the uncertainties associated with the source/receptor relationship. This major assessment is under way and should be completed in FY 1985.

Chapter 15

Mathematical and Computer Sciences in the FY 1985 Budget

Conference Board of the Mathematical Sciences
R.D. Anderson (Marcia Sward, coordinator)

Distribution of Federal Support

NSF is the only Federal agency with responsibility for support across the entire spectrum of the mathematical sciences. Research in the mathematical sciences is also funded by the Department of Defense (DOD), the Department of Energy (DOE), the National Institutes of Health (NIH), the National Aeronautics and Space Administration (NASA), and the National Bureau of Standards (NBS). For the past decade the research agencies of the DOD have focused their support on applied mathematics and statistics. Even in these areas, Foundation-supported research generally involves a broader range of topics than the more project-oriented research sponsored by the mission agencies.

The NSF role in support of academic basic research in the mathematical sciences is crucial. In FY 1983, the Foundation provided 35 percent of the support in applied mathematics, 45 percent in statistics and probability, and 97 percent in the other mathematical sciences disciplines, for an overall total of 61 percent.

Computer research is funded by several Federal agencies, but NSF is the agency with primary responsibility for the support of basic research in this area. Other Federal programs support computer research which is relevant to their respective missions. NSF responds to unsolicited proposals which are evaluated by peer review. As a result, NSF support plays a unique role in strengthening the academic base of computer research and developing the research discipline. The relative fraction of NSF support varies widely among subareas. Overall, in FY 1983 the Foundation supported approximately 32 percent of the Nation's university-based computer research. Details of support by other agencies are given below.

Overview

There are two noteworthy thrusts in funding for the mathematical and computer sciences for FY 1985. The first is the significantly increased level in DARPA (The Defense Advanced Research Projects Agency) and in NSF for what is called by DARPA Strategic Computing and by NSF Scientific Computing Resources. There is a companion computing effort in DOE (Department of Energy). The second is the increased funding for the Mathematical Sciences by NSF, noticeably in excess of overall NSF research funding percentage increases. Both thrusts continue patterns started in FY 1984. DARPA is increasing funding for Strategic Computing from $50 million in FY 1984 to $95 million in FY 1985 and the NSF is increasing funding for Scientific Computing Resources from about $6 million in FY 1984 to about $20 million in FY 1985. In the DOE Applied Mathematical Sciences budget, the increase, primarily for computing efforts, is from $14 million to $30 million. In the Mathematical Sciences Division of NSF, overall funding levels are up from $34.75 million for FY 1983 to $41.5 million for FY 1984 to $50.5 million in the FY 1985 budget, representing an almost 50 percent increase over two years. Other Federal programs reported here generally have rather modest increases.

I. National Science Foundation

Science and Engineering Education (SEE)

The FY 1985 budget request for SEE is $75.7 million, up $0.7 million from the FY 1984 New Obligation Authority. No funds are earmarked for mathematics or computer science education, per se, but a substantial amount will be spent in these areas. The FY 1985 support is distributed as follows:

Graduate Research Fellowships ($21.0 million). This represents an increase of $0.7 million or 3.4 percent above the FY 1984 total of $20.3 million and will support 550 new fellowships for an overall total of approximately 1,550 fellowship offers. The annual stipend for graduate fellows increases from $8,100 to $9,000 and the annual cost-of-education allowance will be $4,900, the same as in FY 1984.

Precollege Science and Mathematics Education ($54.7 million). This amount is the same as the FY 1984 New Obligation Authority and will provide support for teacher development and incentives, new instructional materials, special studies to gain a better understanding of precollege science education in the U.S., research in teaching and learning, informal science education, and activities to publicize and disseminate information about highly successful programs and outstanding research efforts.

There is no money earmarked in the SEE budget for post-secondary science and mathematics education.

Mathematical and Computer Sciences

Since last year's report, the Mathematical and Physical Sciences Directorate (MPS) has split the Division of Mathematical and Computer Sciences into two separate Divisions; Mathematical Sciences and Computer Research. As part of the National Science Foundation responsibility for support across the broad range of academic-based scientific and engineering research activities, a modest effort (about $6.0 million) was initiated in FY 1984 to provide access to advanced computational resources. The FY 1985 plan extends and expands the activities begun in FY 1984, reaching a level of approximately $20.0 million. This amount will be used to provide access to advanced computers, for appropriate networking capability, and to support such local user needs as equipment, software, communications costs, remote workstations, local area networks, technical support, and maintenance. Funds for these activities come from various NSF Directorates and Divisions.

Below are budgets for these various divisions and sections supporting research in the mathematical and computer sciences.

A. Mathematical Sciences

Table I gives the Mathematical Sciences budget by program element. The FY 1984 Current Plan was slightly down, 1.6 percent, from the FY 1984 budget request, almost exactly the percentage reduction for the whole MPS Directorate.

For the second year in a row, there is a large increase in the Mathematical Sciences Budget. The percentage increase (21.7 percent) compares with 15.0 percent to 16.1 percent increases in the other major existing divisions of the MPS Directorate. The larger increases cited below in the Applied Mathematics and Statistics and Probability programs are due in part to relatively low increases in DOD funding for mathematics and thus the need for NSF to pick up statistically some grantees from DOD areas.

The FY 1985 Budget Request permits a modest increase in the number of senior investigators supported and a continuation of the FY 1984 intiatives, with emphasis on programs in support of graduate students and young investigators and on the provision of computational equipment necessary for

TABLE I
NSF-Mathematical Sciences (Thousands of $)

Program Element	Actual FY 1983	Current Plan FY 1984	Estimate FY 1985	%Increase FY 1985/84
Classical Analysis	$ 3,223	$ 3,900	$ 4,800	23.1
Modern Analysis	3,401	4,100	4,950	21.8
Geometric Analysis	3,138	3,800	4,700	23.4
Topology and Foundations	4,327	4,900	5,850	22.9
Algebra and Number Theory	5,599	6,550	7,850	23.8
Applied Mathematics	4,137	5,280	6,700	30.9
Statistics and Probability	3,679	4,670	6,000	32.0
Special Projects	7,257	8,300	9,650	8.0
Total	$34,756	$41,500	$50,500	21.5

the conduct of research. Increased support is also provided for research conducted at undergraduate institutions and for activities supportive of mathematics education, such as workshops and conferences including members of the research and educational communities.

There are modest increases in postdoctoral and visitor support and essentially level support for the Mathematical Sciences Research Institutes at Berkeley and Minnesota. About 60 percent of the researchers supported there are postdoctoral and young researchers.

There is a major percentage increase from $3.6 million to $6.4 million for the support of graduate research assistants on research grants to established senior investigators.

An increase of $0.5 million to a total of $1.2 million is to be devoted to the support of international research activities and to the funding of research at predominantly undergraduate institutions.

There are major percentage increases from $1.4 million to $3.0 million for research support for young investigators and postdoctoral research associates and from $3.6 million to $6.4 million in the support of graduate research assistants funded in research grants to established senior investigators.

B. Computer Research

A breakdown of the budget of the Computer Research Division by program element is given in Table II.

The FY 1985 Budget Request for Computer Research is $39.35 million. This is an increase of $5.45 million or 16.1 percent above the FY 1984 Current Plan and provides modest real growth, especially in experimental computer research. New coordinated experimental research facilities will be added following the plan established four years ago for strengthening academic research activity and research project support will be increased in both experimental and theoretical program elements. Research project support has been constrained for several years to allow the Foundation to initiate its program of Coordinated Experimental Research (CER) facilities grants. This program has helped prepare the way for greater participation by academic scientists in long range experimental research and it is now important for the Foundation to increase project support in response to new opportunities.

TABLE II
NSF-Computer Research (Thousands of $)

Program Element	Actual FY 1983	Request FY 1984	Current Plan FY 1984	Estimate FY 1985	%Increase FY 1985/84
Theoretical Computer Science	$ 3,355	$ 3,700	$ 3,700	$ 4,300	16.2
Software Systems Science	3,151	3,700	3,700	4,200	13.5
Software Engineering	3,068	3,500	3,400	3,700	8.8
Intelligent Systems	3,017	3,500	3,400	3,650	7.4
Computer Systems Design	3,118	3,600	3,500	4,000	14.3
Coordinated Experimental Research	11,180	13,725	13,700	16,700	21.9
Special Projects	1,222	1,450	1,100	1,150	4.5
Computer Research Equipment	1,228	1,500	1,400	1,650	17.9
Total	$29,339	$34,675	$33,900	$39,350	16.1

Support for coordinated experimental research facilities will be increased by $3.4 million or 26.2 percent, to a total of $16.4 million. This will permit the addition of 4-5 new facilities bringing the estimated total to 22-24. Support for the Computer Science Network (CSNET), the other activity in the Coordinated Experimental Research program element, will be reduced by $0.4 million to $0.3 million, or by 57.1 percent, reflecting the continuing shift of that project toward self-supporting status.

The research equipment program will be increased by $0.25 million, or 17.9 percent, to a total of $1.65 million. This increase will provide partial support for the first year maintenance costs for NSF-supported equipment.

Research project support will be increased by $2.2 million, or 11.7 percent, to a total of $21.0 million. This will allow support of new opportunities in experimental and theoretical computer research projects in areas such as algorithms for parallel architecture computers, probabilistic algorithms, software systems for parallel computers, and experimental studies of novel computer architectures.

C. Electrical, Computer and Systems Engineering

The budget is increased by $8.7 million from $36.0 million to $44.7 million with added emphasis on microstructure fabrication research, integrated optical devices, automated design, microsensors, and robotics to aid the handicapped, and optimization methods for productive scheduling in industrial processes. See Table III. Note that the budget comes from the Engineering Directorate at NSF, not from the MPS Directorate.

D. Information Science and Technology

Funding is increased by $0.5 million from $6.1 to $6.6 million. The additional funds will allow continued support for research in selected areas of information technology and information impart which will generate fundamental knowledge bearing directly on current advances in electronic and computing machinery. See Table IV for budget details. Note that Information Science and Technology is funded as part of the NSF Biological, Behavioral and Social Sciences Directorate.

II. Department of Defense

DOD support of R&D in the mathematical and computer sciences is accomplished primarily through the following arms of the various departments: (1) the Army Research

TABLE III
NSF-Electrical, Computer, and Systems Engineering (Thousands of $)

Program Element	Actual FY 1983	Current Plan FY 1984	Estimate FY 1985	%Increase FY 1985/84
Automation, Instrumentation, and Sensing Systems	$ 2,950	$ 3,700	$ 4,800	29.7
Electrical and Optical Communications	5,117	6,177	7,330	18.7
Computer Engineering	2,639	3,700	5,100	37.8
Quantum Electronics, Waves and Beams	4,669	5,300	6,900	30.2
Solid State and Microstructures Engineering	5,513	7,000	8,300	18.6
Systems Theory and Operations Research	4,616	5,300	6,400	20.8
Bioengineering and Research for the Handicapped:				
Bioengineering	2,000	2,500	3,050	22.0
Science and Technology to Aid the Handicapped	2,027	2,300	2,850	23.9
Total	$29,531	$35,977	$44,730	24.3

TABLE IV
NSF-Information Science and Technology (Thousands of $)

Program Element	Actual FY 1983	Current Plan FY 1984	Estimate FY 1985	%Increase FY 1985/84
Information Science	$ 4,001	$ 4,000	$ 4,000	0.0
Information Technology	670	1,000	1,300	30.0
Information Impact	807	1,100	1,300	18.2
Total	$ 5,478	$ 6,100	$ 6,600	8.2

TABLE V
ARO-Mathematical Sciences Division (Thousands of $)

Subactivity	Actual FY 1983	Current Plan FY 1984	Estimate FY 1985	%Increase FY 1985/84
Applied Analysis and Physical Mathematics	$ 1,950	$ 1,800	$ 1,930	7.2
Numerical Analysis and Scientific Computing	1,850	1,700	1,900	11.8
Statistics, Probability and Operations Research	1,450	1,450	1,550	6.9
Systems Theory Control, Modelling and AI	1,115	1,200	1,450	20.8
Conferences and Special Projects	160	160	170	6.2
Total	$ 6,525	$ 6,310	$ 7,000	10.9

Office (ARO), (2) the Office of Naval Research (ONR), (3) the Air Force Office of Scientific Research (AFOSR), (4) the Defense Advanced Research Projects Agency (DARPA). The first three are much alike in their method of operation. DARPA differs in that it is not attached to any one Department and is not strongly focused on basic research.

Army Research Office

In Table V are listed the various programs of the Mathematical Sciences Division. A certain amount of R&D is carried on in Army laboratories such as Aberdeen, Picatinny, and Watervliet. This has been estimated to amount to about $1 million in FY 1983, and is not included in Table V.

The support for the Mathematics Research Center at the University of Wisconsin is imbedded in Items A-D at a continuing level of $2.2 million. The effort in Army labs is estimated at $1 million in FY 1983 and FY 1984.

Air Force Office of Scientific Research

Table VI gives the budgets of the various topics with their usual connotations except that Information Electronics refers to mathematics related to electronic communication.

The programs listed include, for the three fiscal years, special initiatives accounting for the changes in funding. For example, in computational mathematics, there is a $900 thousand initiative for fast algorithms for FY 1985.

The Air Force also supports a substantial amount of R&D intramurally at various Air Force installations, for a total of about $ 1.7 million in FY 1984. The work is highly mission oriented, with about a 33-67 split between computer science and mathematically oriented research.

Office of Naval Research

There are now two divisions supporting research in the mathematical and computer sciences.

A. Information Sciences Division

The Information Sciences Division is concerned with research in such topics as: computer architecture, robotics and advanced automation, artificial intelligence and software engineering. At present there is a particular focus in

TABLE VI
AFSOR-Mathematical and Information Sciences (Thousands of $)

Topic	Actual FY 1983	Current Plan FY 1984	Estimate FY 1985	% Increase FY 1985/84
Control Theory	$ 1,400	$ 2,350	$ 2,530	8
Computational Mathematics	1,850	2,100	2,700	29
Physical Mathematics	845	959	981	2
System Science	1,340	1,350	1,300	-4
Total Applied Mathematics	$ 5,435	$ 6,759	$ 7,511	11
Probability & Statistics	1,925	3,403	2,495	-37
Computer Science	3,985	4,205	4,135	-2
Information Electronics	605	605	605	0
Total	$11,950	$14,972	$14,746	-2

this Division on (1) computer architecture and algorithms for highly parallel computation, (2) artificial intelligence and robotics, and (3) theoretical foundations of software. The budget is given in Table VII.

B. Mathematical Sciences Division

The Mathematical Sciences Division is composed of two groups: (1) a Mathematics Group and (2) a Statistics and Probability Group. The budgets are given in Table VIII.

There are two new thrusts worth noting. A new line item, Discrete (Pure) Mathematics, with a budget of $846 thousand has been added for FY 1985. In the SRO (Selected Research Opportunities) effort, there is an emphasis on Topological and Graph Theoretic Methods for Chemistry with a prospective budget, depending on proposals selected, from $600 to $1000 thousand. Half of this amount comes from the Mathematical Sciences Division, the rest from Chemistry. Some reductions in budget categories from FY 1983 to FY 1984 to FY 1985 in Table VIII reflect the phasing out of earlier SRO efforts.

The figures in Table VIII do not contain monies which ONR handles for R&D work at the Naval Research Laboratory, Naval Air Systems Command, Naval Sea Systems Command and the Naval Electronic Systems Command. In the past, the order of magnitude of funds for each of these was about $1 million except for NRL funds which have been somewhat larger.

Defense Advanced Research Projects Agency

This agency appears to be the central motive office for long range R&D within DOD. DARPA's role is analogous to that of the corporate research division of private sector organizations. Because of this, DARPA is able to initiate investigations in new directions or involving new concepts applicable to military departments without regard to role or mission limitations. A key element of the DARPA mission is its ability to effect the transition from research effort to development and application. DARPA accomplishes this by the execution of research programs through appropriate Service agents for performance by inhouse R&D laboratories or by contracts awarded to university or industrial organizations.

DARPA does not have well-defined programs in either the mathematical or computer sciences or in basic, as opposed to applied, research. The Agency's Information

TABLE VII
ONR-Information Sciences Division (Thousands of $)

Program	Actual FY 1983	Current Plan FY 1984	Estimate FY 1985	%Increase 1985/84
Systems and Devices	$ 563*	$ 512	$ 582	13.7
Theory and Techniques	3,536*	3,216	$3,652	13.6
Total	$4,099*	$3,728	$4,234	13.6

* Actual FY 1983 figures not available. Figures given are those from last year's current plan for FY 1983.

TABLE VIII
ONR-Mathematical Sciences Division (Thousands of $)

Group or Program	Actual FY 1983	Current Plan FY 1984	Estimate FY 1985	%Increase 1985/84
Mathematics				
Applied Mathematics	$ 2,745	$ 2,872	$ 2,950	2.7
Numerical Analysis	2,885	2,929	3,086	5.4
Operations Research (Math.)	1,623	1,480	1,368	-7.6
Discrete Mathematics	-0-	-0-	846	-
Statistics and Probability				
Statistics	$ 3,866	$ 3,179	$ 3,596	13.1
Operations Research (Stoch.)	1,080	970	725	-25.3
Basic Systems Research	568	517	684	32.3
Total	$12,765	$11,947	$13,255	10.9

Processing Technology Office supports research at the level of about $80 million, up slightly from earlier years. The main new thrust at DARPA is in strategic computing initiated in FY 1984 at $50 million and rising in FY 1985 to $95 million as part of a several-agency effort.

III. National Aeronautics and Space Administration

The National Aeronautics and Space Administration (NASA) supports a very considerable amount of R&D, much of it in basic research, in all disciplines connected with its basic mission. This is carried out in-house in NASA centers and laboratories and extramurally through grants and contracts. Support for the mathematical sciences is relatively small, while that for computer science is considerably larger. In fact, NASA does not support research in the mathematical sciences per se, but only those portions which have direct relevance to the NASA mission, e.g., control theory, numerical work in ordinary and partial differential equations, theoretical and numerical fluid mechanics.

Table IX gives a breakdown of basic and applied university and college research support based on best available estimates and judgements. The amounts differ somewhat from those reported last year, particularly in basic computer science support, perhaps due to reclassification and some tranfer of funds. Intramural research at some of NASA's facilities is not included but several years ago was estimated to be about $800 thousand.

IV. National Institutes of Health

The NIH is so organized and the principal focus of the extramural research which it supports is of so complex a nature that it is difficult to obtain data on the support of of a specific discipline. There are no specific programs of support for mathematics, mathematical sciences, or computer science. What one finds instead is that for each grant or contract an estimate is made of the fraction of the research done thereon which is attributable to mathematics, chemistry, etc. The total of such fractions converted to dollars is reported as the support for that discipline.

In other words, support for mathematical sciences is a secondary biproduct of other support. It should be noticed that mathematics, but not computer science, is reported. See Table X.

TABLE IX

NASA-Mathematics and Computer Science (Thousands of $)
Research Performed at Universities and Colleges

Classification	Actual FY 1983	Current Plan FY 1984	Estimate FY 1985	%Increase FY 1985/84
Mathematics (Basic)	$ 757	$ 900	$ 1,000	-
(Applied)	77	100	100	-
Computer Science				
(Basic)	2,384	2,600	3,000	-
(Applied)	1,062	1,200	1,300	-
Mathematics/Computer Science (N.E.C.) (Basic)	948	1,000	1,100	-
Mathematics/Computer Science (N.E.C.) (Applied)	120	100	200	-
Total	$5,348	$5,900	$6,700	13.6

Note: N.E.C. means Not Elsewhere Classified, and is used for interdisciplinary projects and others not listed by discipline name. This is a formal classification specified by OMB Circular A-46. Detailed percentage changes are not given because figures for 1984 and 1985 are rounded off estimates.

TABLE X
NIH-Mathematical Sciences Budget Authority (Thousands of $)

Type of Research	Actual FY 1983	Current Plan FY 1984	Estimate FY 1985	%Increase FY 1985/84
Mathematics (Basic)	$ 5,896	$ 6,523	$ 6,614	1.4
Mathematics (Applied)	3,695	4,044	4,070	0.6
Total	$ 9,591	$10,567	$10,684	1.1

TABLE XI
National Bureau of Standards (Thousands of $)

Program	Actual FY 1983	Current Plan FY 1984	Estimate FY 1985	%Increase FY 1985/84
Center for Applied Mathematics (Includes Scientific Computing Division)	$ 5,141	$ 5,226	$ 5,605	7.3

V. National Bureau of Standards

The National Bureau of Standards (NBS) in the Department of Commerce has within its National Engineering Laboratory a Center for Applied Mathematics. The Center, which comprises Divisions of Mathematical Analysis, Statistical Engineering, Operations Research, Scientific Computing, and Computer Services, has as its primary goal to ensure that the most appropriate mathematical, computational, and statistical procedures are available for use in the NBS technical programs. The operations of the Center are entirely in-house, and in part these operations involve R&D in the mathematical and computer sciences. See Table XI.

VI. Department of Energy

Activities supporting R&D in the mathematical and computer sciences are lodged primarily in a program of Applied Mathematical Sciences. This program consists of two activities: Supercomputing Research and Energy Science Advanced Computation. The Supercomputing Research program funds basic research at national laboratories, universities, and private research institutions in three major categories: Analytical and Numerical Methods, Information Analysis Techniques, and Advanced Computing Concepts. In FY 1985, there will be increments of $1.5 million, $1.85 million and $3.23 million, respectively, in these programs. In addition, experimental computing capabilities are being established at research facilities to support the exploration of new concepts in large-scale scientific computing, with a total of $21.25 million in operating funds planned for FY 1985, an increment of $6.58 million over the FY 1984 level.

The Energy Science Advanced Computation budget will be increased to a total of $7.0 million as a first step in expanding energy research computing activities on the existing Magnetic Fusion Energy Computer Network to supply the large-scale computing needs of the High Energy and Nuclear Physics, Basic Energy Sciences and Biological and Environmental Research Programs.

TABLE XII

DOE-Applied Mathematical Sciences Program (Thousands of $)

Area	Actual FY 1983	Current Plan FY 1984	Estimate FY 1985
Analytical & Numerical Methods	$ 6,800	$ 7,000	$ 8,500
Information Analysis Techniques	2,000	2,100	3,950
Advanced Computer Concepts	5,050	5,570	8,800
Energy Science Advanced Computation			7,000
Operating Equipment			1,500
Total	$13,850	$14,670	$29,750

Chapter 16

Biology in the FY 1985 Budget

American Institute of Biological Sciences
Claudia Feller

There are few surprises in President Reagan's proposed FY 1985 research and development budget for biologists. Life sciences, once again, get very little of the R&D pie.

Funding for basic research by agencies supporting primarily life sciences would be $3.5 billion, a 5 percent increase over FY 1984. In contrast, basic research by agencies supporting primarily physical sciences and engineering would receive $4.4 billion or 14 percent more than last year.

Of the more than ten new federal projects highlighted at the Office of Science and Technology Policy budget briefing, only one--an expanded Competitive Grants program at USDA to include agricultural biotechnology--was in life sciences.

The National Science Foundation continues to be the focal point for Administration R&D nondefense spending. NSF receives a 14 percent increase in R&D funding, but relatively little of the money is going to the biological sciences:

- Mathematical and Physical Sciences support is $416.7 million, a 16.1 percent increase.

- Engineering support is $147.1 million, a 22 percent increase.

- Astronomical, Atmospheric, Earth and Ocean Sciences support is $373.5 million, a 13.2 percent increase.

- Biological, Behavioral and Social Sciences support is $253.1 million, a 12.7 percent increase.

Department of the Interior

The Department of the Interior is asking for a total budget of $6.5 billion for FY 1985, about $100 million less than it received in FY 1984. Total requested funding for the Fish and Wildlife Service and the National Park Service is $1.4 billion. A major change this year is the priority being given to land acquisition by both Services.

The FWS, which requested no money for land acquisition last year, is asking for $57.5 million in FY 1985, $15.2 million more than Congress forced it to take last year. Of this total, $30.0 million would go toward acquiring 45,540 acres in fourteen national wildlife refuges (35 percent of the land being recognized endangered and threatened wildlife habitat), $20.0 million would be used to acquire 21,035 acres of wetlands (although federal legislation specifically mandating this action--already proposed in Congress--may be required before FWS can buy the land), and $7.5 million would go to state wetland acquisition programs.

The National Park Service has requested $100 million for land acquisition, $45.3 million more than the Administration asked for last year and $7.5 million more than Congress appropriated.

Obligations for the conduct of research and development at the Interior Department for FY 1985 are estimated at $363 million, a decrease of $52 million. $111 million of these R&D funds will go to the Fish and Wildlife Service--an increase of $5 million. At FWS, major increases are proposed for federal aid to state fish and wildlife agencies and for acid rain studies. They will support research activities concerned with:

- habitats of waterfowl, migratory and nonmigratory birds, and mammals;
- status and distribution of endangered and threatened species;
- impact of broad-scale environmental changes on fish and wildlife populations and habitat; and
- diseases of freshwater and anadromous fish.

Total funding for FWS is up $16.3 million. A major funding initiative in this request accelerates federal efforts to preserve valuable wetlands. This initiative provides funds for grants to states for wetlands conservation, federal wetlands acquisition, and a study of wetlands losses and recommendations for conserving these areas.

The second major thrust of the FWS FY 1985 budget

emphasizes monitoring and research efforts directed toward the effects of contaminants and techniques of lake liming on fish and wildlife.

Offsetting reductions in FWS's FY 1985 budget include:

• Consolidating cooperative fish and wildlife research units to achieve management efficiencies while continuing research and training activities. By combining both fields of research at the same universities, total savings will be $1.3 million. In FY 1985, a total budget of $3.7 million is proposed for the cooperative units.

• Effecting the transfer/closures of ten national fish hatcheries as directed by Congress during the FY 1984 appropriations. This process will result in operational savings of $1.4 million.

• Terminating lower priority research activities including fish control and drug registration and small mammal damage to forests, and effect savings for previous one-time maintenance costs ($1.2 million).

FWS is asking for $25.2 million for endangered species this year, $3.3 million more than it received last year. The increase will go primarily toward accelerated listing of species and new recovery actions on priority species including the whooping crane, Delmarva fox squirrel, bald eagle, grizzly bear and masked bobwhite. The Service would also double endangered species grants to the states.

Funding at the National Park Service is down $94.1 million. Proposed reductions include $81.2 million for assistance to states under the Land and Water Conservation Fund and $75 million for grants-in-aid to states for park development or acquisition projects.

DEPARTMENT OF THE INTERIOR
(in millions)

	FY 1983 Actual	FY 1984 Estimate	FY 1985 Request
FISH AND WILDLIFE AND PARKS			
Fish and Wildlife Service	$ 496.41	$513.53	$529.79
National Park Service	1,080.15	935.02	840.91
ENDANGERED SPECIES			
Listing	$ 2.06	$ 2.58	$ 3.03
Protection/Law Enforcement	5.77	6.13	6.26
Consultation	2.54	2.57	2.65
Recovery	5.13	4.58	4.98
Research and Development	2.97	4.09	4.32
Grants (to States)	2.00	2.00	4.00

Department of Agriculture

The biggest ray of sunshine in USDA's proposed FY 1985 budget is the $19.1 million increase for the Cooperative State Research Service. A more modest increase is proposed for the Agricultural Research Service, and the Forest Service is slated for a decrease in research funding.

CSRS, which administers federal funds for research at the state agricultural experiment stations and other eligible institutions, will receive $28.5 million for a major new biotechnology initiative if Congress goes along with the President's request. The funds will be distributed through the competitive grants process. In addition, $4.5 million is requested to establish a new program in competitive grants for basic animal science research to expand fundamental research in support of efficient animal production. Total funding for Competitive Research Grants will be increased to the maximum authorized by law—$50 million.

CSRS Special Research Grants will be reduced by $11 million. Acid rain research will get $695,000, and six other areas of research are slated for funding: pesticide clearance ($1.44 million), minor use animal drugs ($240,000), pesticide impact assessment ($2.07 million), animal health ($7.16 million), germplasm resources ($902,000), and tropical and subtropical research ($2.98 million).

The Agricultural Research Service will receive an increase of $8.3 million. There will be a $2.6 million increase in Animal Science to accelerate genetic improvements, improve animal disease resistance and support APHIS animal protection programs. There will be over $5 million more in Plant Science to modify plant germplasm, strengthen biological control of pests, support the APHIS plant quarantine program and integrate research in various disciplines.

The Forest Service staff-year ceiling for FY 1985 is 750 below the FY 1984 level which is 1,600 below the FY 1983 level. The FY 1985 budget for State and Private Forestry is about $35 million below the FY 1984 current estimate. Other than a $3 million grant to Minnesota, grants to the states are terminated. The proposed reduction of about $6 million from the FY 1985 Forest Research budget would mean closing small laboratories in Tennessee and Missouri and reducing the work at other labs. About 100 to 150 staffers would be out of work. In the last few years Forest Service Research has been a particular target for budget reduction. In the recent past the total budget for Research was approximately $120 million.

DEPARTMENT OF AGRICULTURE
(in millions)

	FY 1983 Actual	FY 1984 Estimate	FY 1985 Request
AGRICULTURAL RESEARCH SERVICE			
Animal Science	$ 82.2	$ 82.3	$ 84.9
Plant Science	180.7	185.2	190.7
Soil and Water Conservation	60.7	63.6	65.7
Processing, Storage and Food Safety	86.6	89.6	93.2
Human Nutrition	31.7	34.1	34.4
COOPERATIVE STATE RESEARCH SERVICE			
Hatch Act Formula	$149.3	$152.3	$ 155.3
1890 Colleges and Tuskegee Formula	22.4	22.8	23.3
Cooperative Forestry Formula	12.5	12.7	12.5
Special Research Grants	27.7	26.5	15.5
Competitive Research Grants			
Plant Science	15.0	15.0	15.0
Human Nutrition	2.0	2.0	2.0
Animal Science	---	---	4.5
Biotechnology	---	---	28.5
Animal Health and Disease Formula (Sect. 1433)	5.8	5.8	---
Federal Administration (Direct Appropriation)	0.2	0.6	0.2
1890 Research Facilities Construction	10.0	10.0	10.0
FOREST SERVICE			
Forest Research	$107.1	$109.4	$ 103.1
ANIMAL PLANT AND HEALTH INSPECTION SERVICE			
Animal Welfare	$ 4.9	$ 4.9	$ 3.7

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National Oceanic and Atmospheric Administration

The Department of Commerce is requesting a budget of $1.6 billion for FY 1985--$352 million less than the amount appropriated in FY 1984. Not surprisingly, the requested budget authority for the National Oceanic and Atmospheric Administration of $899 million is also down from last year--$94 million down. The Administration continues to argue that many of NOAA's programs should be eliminated and their responsibilities and costs borne by other levels of government or the private sector. 27 percent of the Commerce reduction comes out of NOAA. 94 percent of NOAA's reduction is from the two (of a total of five) budget activities of interest to biologists.

Ocean and Coastal Programs at NOAA provide for the management and development of the marine environment and its resources; the conservation, rational use and charting of the nation's coastal regions; production of aeronautical and nautical charts; and geodetic surveys. The funding request for these activities is $37.7 million less than last year. Among programs slated for termination are Undersea Research, Sea Grant Colleges and Coastal Zone Management State Grants. Attempts to scrap the Sea Grant program for the last three years have been stopped by Congress.

Marine Fishery Resource Programs are decreased by almost $51 million. All three budget subactivities are sharply reduced. These programs provide for the management and conservation of the nation's living marine resources, marine mammals and endangered species stocks; and encourage the increased use of the resources through fishery product quality and safety research. The Aquaculture Research and Fisheries Grant programs are being terminated.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
(in millions)

	FY 1983 Actual	FY 1984 Estimate	FY 1985 Request
OCEAN AND COASTAL PROGRAMS			
Non-Living Marine Resources	$ 3.04	$ 3.77	$ 1.31
Ocean Research	37.88	26.86	17.99
Ocean Services	14.32	27.13	19.09
Sea Grant	35.14	36.50	---
Coastal Zone Management	---	---	5.59
Mapping, Charting & Geodesy	48.16	49.61	62.16
MARINE FISHERY RESOURCE PROGRAMS			
Info. Collection & Analysis	$71.23	$71.84	$59.13
Conservation & Management	73.63	50.50	29.41
State & Industry Programs	17.88	21.26	4.09

National Institutes of Health

The proposed FY 1985 budget for the National Institutes of Health of $4.6 billion will not keep pace with inflation. It increases $89 million--only 2 percent more than NIH is expected to spend during FY 1984. Emphasis is placed on basic biological and genetic research rather than research aimed at finding cures for specific illnesses. Still, the biggest increases for research would go to Dental and Allergy and the smallest to Child Health, and funds have been allocated for the study of acquired immune deficiency syndrome and Alzheimer's disease.

The Administration emphasizes that the budget would provide enough money to finance 5,000 new research grants and some 12,100 ongoing projects. The average research project grant award will increase by 5 percent and indirect costs will be reimbursed in full. However, the indirect costs issue will continue to be reviewed by the Department of Health and Human Services.

National Aeronautics and Space Administration

NASA's total request for FY 1985 is $7.5 billion (+4 percent), of which $3.5 billion (+2 percent) is for research and development. However, the Space Science and Applications budget will increase by 11 percent, to $1.4 billion. The modest Life Sciences program will increase $5.3 million. This program will continue to provide for the research and technology required to meet the goals of ensuring human health, safety, well-being and performance in space; using the space environment to advance knowledge in earth medicine and biology; and understanding the origin and distribution of life in the universe.

During 1985, the Life Sciences Flight Experiments development activities will continue, leading to a series of reflyable dedicated life sciences Shuttle/Spacelab missions, the first of which is scheduled for launch in late 1985.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
(in millions)

	FY 1983 Actual	FY 1984 Estimate	FY 1985 Request
SPACE SCIENCE AND APPLICATIONS			
Life Sciences			
Flight Experiments	$ 24.0	$ 23.0	$ 27.1
Research and Analysis	31.7	35.0	36.2

Department of Defense

At $34.2 billion, obligations for Department of Defense research and development, including R&D facilities, comprise about 65 percent of total federal funding for R&D in FY 1985. Only $939 million of those funds is designated for basic research. DOD seems to be the one notable exception to the Administration's professed commitment to shift federal R&D funding from applied to basic research. Defense basic research, primarily in the physical sciences, funds programs such as chemical warfare protection and environmental research "important to the military mission."

National Science Foundation

Funding for NSF's Biological, Behavioral and Social Sciences Directorate is up 12.7% or $28.4 million from FY 1984. The FY 1985 BBS budget request is $253.1 million. In biology, the emphasis--like last year--is on plant sciences. Although NSF Director Knapp stressed the importance of basic research, it seems, at least in the biological sciences, that the focus is really on potentially applicable science (agricultural biotechnology, for example.)

Physiology, Cellular and Molecular Biology is increased $14.3 million from $102.1 million to $116.4 million. The increase will allow a continued emphasis in the plant sciences to advance the understanding of plants through application of both contemporary molecular and cellular approaches and instrumentation technologies. Additional emphasis will be placed on research using genetic methods to examine fundamental biological questions and on the chemistry of biological processes. Continued attention will be paid to providing funds for research instrumentation and research resources.

Biotic Systems and Resources is increased by $6.5 million from $53.4 million to $59.9 million. The increase will allow a continued emphasis in the plant sciences, including research on the role of plant toxins in controlling damage by insects, and on plant adaptation to nutrient limitations. Emphasis will be placed on augmenting awards to permit use of instrumentation and materials essential for the application of molecular genetic techniques to studies of systematics and population biology. The program to refurbish marine biology laboratories will be continued.

In the neurosciences a $3.0 million increase will be used primarily for instrumentation and increasing award sizes for the most promising projects.

NATIONAL SCIENCE FOUNDATION
(in millions)

BIOLOGICAL, BEHAVIORAL AND SOCIAL SCIENCES DIRECTORATE	FY 1983 Actual	FY 1984 Estimate	FY 1985 Request
Physiology, Cellular and Molecular Biology			
Biochemistry	$ 11.38	$ 12.85	$ 14.65
Biophysics	10.71	12.36	14.39
Genetic Biology	12.18	14.90	17.15
Metabolic Biology	11.59	14.00	15.40
Alternative Biological Resources	2.06	2.35	2.59
Cell Biology	9.11	10.23	11.60
Cellular Physiology	6.40	7.41	8.33
Developmental Biology	10.32	12.61	14.40
Regulatory Biology	8.22	8.86	9.96
Biological Instrumentation	5.37	6.50	7.90
Biotic Systems and Resources			
Ecology	$ 7.46	$ 8.03	$ 9.28
Ecosystem Studies	15.14	16.77	18.46
Systematic Biology	8.76	11.00	12.33
Population Biology and Physiological Ecology	6.86	8.80	10.04
Biological Research Resources	7.74	8.80	9.77
Neural Sciences			
Molecular and Cellular Neurobiology	$ 4.70	$ 4.60	$ 5.30
Integrative Neural Systems	3.74	4.20	5.00
Developmental Neuroscience	3.26	4.70	5.48
Sensory Physiology and Perception	5.77	6.80	7.30
Psychobiology	3.87	4.20	4.40

Environmental Protection Agency

The FY 1985 EPA budget of $4.2 billion (+ 7 percent) will strengthen research in four areas: acid rain, assessment of technology for the control of pollutants, human health effects of environmental pollutants, and risk assessment of hazardous and toxic chemicals (under this EPA will begin researching the potential impacts of genetically engineered organisms on the environment).

Department of Energy

There will be more money for the nation's only long-term research effort specifically focused on energy related health and environmental issues. A $5.1 million increase in DOE's Biological and Environmental Research program has been proposed for FY 1985. Specific activities planned in BER this year include studies of the health and environmental effects of radiation and other energy-related pollutants and studies to provide basic information on pollutant-induced damage in biological systems.

Requested funding for the Environment, Safety and Health program is up $5 million. Proposed for close out, however, is the Liquefied Gaseous Fuels Spill Test Facility. Its purpose is to develop the safety and environmental control information needed by industry, regulatory agencies and the public on liquefied gases.

Total funding for Basic Energy Sciences will be $419.5 million, a healthy increase from last year's $337.3 million. The BES program is responsible for generic long-range energy related research. Funding for the small Biological Energy Research program is up $2.1 million.

DEPARTMENT OF ENERGY
(in millions)

	FY 1983 Actual	FY 1984 Estimate	FY 1985 Request
ENERGY SUPPLY, RESEARCH AND DEVELOPMENT ACTIVITIES			
Environment			
Environment, Safety & Health	$ 29.3	$ 32.1	$37.1
Spill Test Facility	3.5	3.2	2.0
Biological & Environmental Research	184.6	184.0	189.1
SUPPORTING RESEARCH AND TECHNICAL ANALYSIS			
Basic Energy Sciences			
Biological Energy Research	$ 9.9	$ 11.0	$ 13.1

Chapter 17

Chemical Engineering in the FY 1985 Budget

American Institute of Chemical Engineers
J. R. Hightower, Betsy Houston

This chapter attempts to identify and report on federal programs in which chemical engineers would be "significantly" involved. Because the budget of the United States Government does not specify "chemical engineering," it is necessary to use additional sources to help identify those programs with a "significant" chemical engineering component. The definition of the term "significant" here is not precise. The selection of programs for inclusion here is based upon the judgement of the author and the general description of objectives and activities, where available, in the individual agency justification documents. The depth of the analysis of these selected federal programs affecting chemical engineers reflects the extent to which sources were available and there was time for the author to exploit them.

The federal agency which provides the bulk of federal R&D funds for chemical engineering-related projects is the Department of Energy. Data were also gathered for the Environmental Protection Agency, National Science Foundation, and the National Bureau of Standards.

Funding for programs which include chemical engineering (not chemical engineering per se) in the agencies for which data were gathered increased from $2.54 billion in FY 1984 to $2.79 billion in FY 1985, an increase of 10 percent. As usual, this overall figure is heavily influenced by the Department of Energy. A more detailed breakdown of these programs is given in the following sections.

Department of Energy

The R&D programs in the Department of Energy include: a National Defense Program related to the development and testing of nuclear weapons; a General Science Program of basic research in nuclear-related sciences; and an Energy Program focused on long-term R&D in support of energy technology development. Obligations for the conduct of all energy R&D are estimated to total $4.9 billion in 1985, an increase of $41 million from 1984. As shown in Table 1, the 1985 funding for R&D programs with significant chemical engineering components are $2.68 billion, an increase of nearly $240 million or 9.8 percent. Major increases are in the Basic Energy Sciences (12 percent increase to $280 million) and in the extremely large Atomic Energy Defense Activities (22 percent increase to $1.99 billion). Nuclear programs decreased 29% to $122 million largely as a result of CRBR cancellation and decrease in associated fuel cycle work. It is interesting to note that High Temperature Reactor R&D increases $4.6 million to $34.6 million in 1985; but this represents the first budget request for such work in a number of years. Fossil energy R&D decreases 21 percent to $108 million. Funds for the uranium enrichment R&D program decreases 39 percent to $115 million reflecting projected decreases in uranium enrichment revenues. In 1985 DOE will choose between the Atomic Vapor Isotope Separation process and the Advanced Gas Centrifuge process for future development, thus focusing the program more narrowly and reducing funding requirements.

National Science Foundation

The National Science Foundation (NSF) supports primarily basic research in all disciplines through grants to scientists and engineers in academic institutions. The 1985 NSF budget includes $1.4 billion in obligations for the conduct of R&D, an increase of $169 million or 14 percent above 1984. Within this total (Table 2) the obligations for funding R&D programs with chemical engineering components increased $11.3 million to $67.8 million or 20 percent above 1984. As shown in Table 2 increases are rather uniform and there were no major decreases. Included in Table 2 is an estimate of the fraction of the budget item which specifically supports chemical engineers. It is felt that these fractions are upper limits and that chemical engineers are actually supported at lower levels.

TABLE 1. DEPARTMENT OF ENERGY

	Estimate FY 1984	FY 1985
ENERGY SUPPLY RESEARCH AND DEVELOPMENT		
SOLAR ENERGY		
• Biofuels Energy Systems	28.4	28.1
NUCLEAR		
• Converter Reactor Systems		
High Temperature Reactors	30.0	34.6
Light Water Reactor Systems	19.5	16.0
Three Mile Island	37.0	32.2
• Civilian Radioactive Waste R&D	11.4	27.6
• Breeder Reactor Systems		
Nuclear Fuel Cycle	35.4	11.9
Clinch River Breeder Reactor	40.0	0
BASIC ENERGY SCIENCES		
• Materials Sciences	137.8	156.9
• Chemical Sciences	82.0	89.7
• Engineering and Geosciences	20.2	22.3
• Advanced Energy Projects	9.4	11.1
URANIUM ENRICHMENT	189.0	115.0
FOSSIL ENERGY RESEARCH AND DEVELOPMENT		
COAL		
• Coal Liquefaction	28.9	13.9
• Surface Gasification	36.8	15.0
• Advanced Research and Tech. Dev.	39.3	40.3
• Control Tech. and Coal Prep.	26.0	32.2
PETROLEUM		
• Advanced Process Technology	5.0	6.2
ENERGY CONSERVATION		
INDUSTRIAL	33.7	33.3
ATOMIC ENERGY DEFENSE ACTIVITIES		
MATERIALS PRODUCTION	1295.8	1622.3
DEFENSE WASTE AND BYPRODUCT MGMT.		
• Interim Waste Operations	221.0	240.4
• Long-Term Waste Mgmt. Technology	64.6	90.4
• Byproducts and Beneficial Use	10.0	0
• Capital Equipment	34.5	35.8
	2435.7	2675.2

TABLE 2. NATIONAL SCIENCE FOUNDATION

	FY 1984	FY 1985
ENGINEERING		
CHEMICAL AND PROCESS ENGINEERING (0.70)		
• Kinetics, Catalysis, and Reaction Engineering	4.50	5.60
• Chemical and Biochemical Processes	5.68	7.18
• Engineering Energetics	3.80	4.21
• Thermodynamics and Transport Phenomena	4.10	4.94
• Particulate and Multiphase Processes	3.90	4.54
• Separation Processes	2.20	3.44
• Minerals and Primary Materials Processing	2.40	2.62
CIVIL AND ENVIRONMENTAL ENGINEERING		
• Environmental and Water Quality Engineering (0.1)	3.30	3.80
MECHANICAL ENGINEERING AND APPLIED MECHANICS		
• Fluid Mechanics (0.2)	5.30	6.40
• Heat Transfer (0.3)	5.86	7.03
MATHEMATICAL AND PHYSICAL SCIENCE		
MATERIALS RESEARCH		
• Metallurgy (0.02)	8.99	10.30
• Polymers (0.2)	6.47	7.78
NSF Total	56.50	67.84

Environmental Protection Agency

The total R&D budget for the Environmental Protection Agency (EPA) increases $31 million to $281 million in 1985 or 12 percent over 1984. Of this total the R&D programs with significant chemical engineering components (Table 3) increase 2.6 percent. Although this is a small increase it reverses the strongly downward trend seen last year. EPA programs involving chemical engineering fall under the Environmental Engineering and Technology Programs for each major medium under the Office of Research and Development.

TABLE 3. ENVIRONMENTAL PROTECTION AGENCY
RESEARCH AND DEVELOPMENT PROGRAMS
(Environmental Engineering and Technology Components)

	FY 1984	FY 1985
AIR		
OXIDANTS	3.17	3.56
GASES AND PARTICLES	3.80	4.37
WATER QUALITY		
WATER QUALITY RESEARCH	0.23	0.38
MUNICIPAL WASTEWATER	0.03	0.03
INDUSTRIAL WASTEWATER	--	--
DRINKING WATER		
DRINKING WATER RESEARCH	6.62	5.40
TOXIC SUBSTANCES		
CHEMICAL TESTING AND ASSESSMENT	0.20	0.68
	14.05	14.42

National Bureau of Standards

The National Bureau of Standards (NBS) conducts research aimed at maintaining and improving a system of measurement required to support the nation's industrial and scientific endeavors. In 1985 the NBS is expected to obligate $91 million for the conduct of R&D. This represents a decrease of $5 million or 5 percent from 1984. The programs with a significant chemical engineering component, however, increase $5.5 million or 17 percent over 1984 to $37.04 million (Table 4). Under Fundamental Physical Measurements and Standards the Process and Quality Control Measurements program will increase $2.5 million (and 20 positions) to fund the development of advanced primary standards and measurement methods to improve industrial productivity and competitiveness through improved process and quality control. Under Chemical Properties and Processes a new program on Industrial Applications of Biotechnology (adding $3.0 million and 28 positions) will develop a scientific basis for the use of biotechnology in chemical production and related industries.

TABLE 4. NATIONAL BUREAU OF STANDARDS

	FY 1984	FY 1985
MEASUREMENT RESEARCH AND STANDARDS		
FUNDAMENTAL PHYSICAL MEASUREMENTS AND STANDARDS	12.09	14.59
CHEMICAL PROPERTIES AND PROCESSES	3.88	6.88
APPLIED MEASUREMENT PROGRAM	2.22	2.22
ENGINEERING MEASUREMENTS AND STANDARDS		
CHEMICAL ENGINEERING METROLOGY	4.42	4.42
ENGINEERING AND PRODUCT STANDARDS	3.32	3.32
MATHEMATICAL SCIENCES	5.61	5.61
	31.54	37.04

Chapter 18

Electrotechnology-Related Research in the FY 1985 Budget

Institute of Electrical and Electronics Engineers
William Herrold, *et al.*

This analysis is intended to highlight federal research and development funding in FY 1985 directed toward programs of interest to the membership of the Institute of Electrical and Electronics Engineers (IEEE). It is not intended to reflect any positions of the Institute on these programs or their funding levels, but to serve as an easy reference to many of the areas of IEEE involvement in U.S. public policy issues. Where possible, program descriptions and dollar amounts are provided. For further data, tables are provided in Parts I and II of this book.

Highlights

For FY 1985, the Administration has proposed a total of $54.3 Billion, a 12.7 percent increase over 1984 as measured in constant dollars. Formidable increases have been directed toward the Defense Department (20.9 percent), the defense and general sciences activities of the Department of Energy (5.3 and 11.3 percent respectively), NASA (11.4 percent), and the NSF (9.2 percent). A greater portion of Federal support for R&D continues to be directed toward defense needs, increasing from approximately 51 percent in 1980 to 65 percent in FY 85. Total defense expenditures for RDT&E will reach $33.9 billion. The civilian energy programs of the Department of Energy continue to decline in emphasis, decreasing 8.5 percent to $2.499 billion between fiscal years 1984 and 1985. The NASA R&D budget is increased to $3.46 billion, partially the result of the new Space Station initiative, which will be funded at $150 million. The NSF budget of $1.43 billion reflects an increase to $147.1 million for the Engineering Directorate.

Additional sources of Federal R&D funding of interest to the IEEE are the Department of Transportation and the Department of Commerce. Within Transportation, FAA reasearch, budgeted at $277.3 million, will support the upgrading of the National Airspace System. For the Department of Commerce, the Administration proposes $271.3 million, reflecting continued decreases in both the National Oceanic and Atmospheric Administration and the National Bureau of Standards.

With regard to the character of the work being performed, there are clear demarcations between defense and civilian missions. Within the Defense mission, about 89 percent of the funding, or $33.0 billion, is allocated toward development, and only about 3 percent, or $899.8 million, devoted to basic research. On the otherhand, about 43 percent of the civilian R&D, or about $6.7 billion, focuses on basic research, with only about 22 percent ($3.4 billion) focused on developmental work. This reflects the policies of the Administration to expedite the integration of new technologies into defense systems, and to deemphasize the role of the Federal government in the development of civilian or commercial technologies.

Finally, Federal support for conduct of R&D at colleges and universities will increase about 5.5 percent in FY 1985, rising to a total of $5.987 billion. Major increases in support for universities will be channelled through the NSF, the Defense Department, NASA and the Department of Energy.

Department of Defense

A high priority of the broader Defense Department R&D program is weapon support and logistics, with three principal thrusts: to demonstrate high payoff support technologies and to accelerate their early transition into the field; to evaluate contractor IR&D with the objective of applying technology to reducing the logistics support of current and future weapons systems; and to include initiatives to increase the productivity of the support system itself. Investments in the Defense Science and Technology Base are intended to support discoveries and technological breakthroughs that can have a force multiplier effect on our defense capabilities. The U.S. continues to rely on superior technology to offset quantitative Soviet advantages in many weapons systems.

Technology Base activity is projected to increase only about 6 percent over estimated 1984 expenditures, increasing from $3.042 billion to $3.226 billion. As a result, Technology Base programs continue to receive a decreasing portion of

total Defense RDT&E, reduced almost 2 percent to 9.5 percent in FY 1985.

Of the $899.8 million devoted to defense Basic research, about 50 percent is performed by universities. The DOD-University Forum continues to address problems such as the exchange of scientific information and the training of the future scientific and engineering manpower base. Also, the Defense Department will continue its university research instrumentation program to upgrade the caliber of this equipment.

The Very High Speed Integrated Circuits (VHSIC) program continues to move ahead with the insertion of high density, high performance integrated circuit chips into military systems. The development of next generation chips with submicron feature sizes is also underway, as well as efforts to reduce production costs.

The Defense Software Technology for Adaptable Reliable Systems (STARS) program seeks improvement of the state-of-the-art and practice of software for mission critical systems.

The DOD Directed Energy Program includes high energy lasers, particle beams and high power microwaves, and seeks their application to both strategic and tactical weapons systems. In 1983 the Airborne Laser Laboratory successfully neutralized in-flight missiles utilizing laser technology. During 1985 an Advanced Test Accelerator will begin testing theories of atmospheric propagation of charged particle beams, and the National Tri-Service Laser Test Range will operationalize the most powerful laser in the free world.

Research of the Defense Advanced Research Projects Agency (DARPA) over the coming year will include superintelligent computers and artificial intelligence, short wavelength laser projects, optical signal processing, a gallium arsenide pilot production line demonstration, and the propagation of charged particle beams in the atmosphere.

Under the Small Business Innovation Research Act, the major R&D sponsoring agencies are required to direct a portion of their R&D funding to promote small business reseach and innovation. Defense Department funds to be available for FY 1985 are estimated to approach $79 million, increased substantially over the $44 million available in FY 1984. Over 3000 research proposals were received by the Department in response to its published solicitation topics in FY 1984.

Department of Energy

Total Department of Energy funding for R&D activity has increased from about $4.7 billion in FY 1984 to $4.78 billion in FY 1985. When measured in constant dollars this represents a decrease of approximately 3.2 percent. Within DOE, funding continues to gravitate toward defense activities which, at over $2.5 billion, accounts for approximately 46 percent of the research conducted by the Department. Funding to conduct civilian energy R&D (both Energy Supply and Fossil) continues to decline, and at less than $2.2 billion, accounts for 40 percent of the Department's research effort. The other 14 percent, or about $747 billion, is devoted to General Science and Research.

The Energy Supply R&D programs of the Department continue to decrease under the policy of the Administration to support longer term, higher risk research, leaving those technologies deemed commercially viable to the marketplace for support. The Administration continues to seek substantial cuts in the Solar and Other Renewables area, down to $191.3 million, approximately an 11 percent reduction from FY 1984. The Solar Energy program, budgeted at $163.6 million, will focus on improved performance of solar heating, cooling, and lighting systems ($11.9 million); improving the efficiency, life and cost of photovoltaic cells ($47.5 million); more cost-effective bioconversion techniques ($28.1 million); advanced wind turbines ($23.3 million); and more reliable ocean thermal energy conversion techniques ($3.5 million). Geothermal energy research, budgeted at $27.1 million, will focus on analyses of duration geopressured resource flow test data, hydrothermal technology, hard rock penetration , magma energy extraction research, and completion of the Fenton Hill, NM Hot Dry Rock Thermal Loop. Hydropower research has been almost entirely turned over to the private sector, and the $.5 million requested is intended to continue the monitoring of cost-shared demonstration projects.

Nuclear Energy Research, budgeted at $523.9 million, reflects a substantial reduction over FY 1984 authority of $624.2 million. This reduction results in part from termination of the Clinch River Breeder Reactor, which reduced breeder program requirements from $423.2 million to $308.1 million. Remaining R&D funding will be used to evaluating advanced breeder concepts. Converter Reactor systems, budgeted at $83.5 million, will support technical and economic evaluations of High Temperature Gas Reactor concepts, research toward resolving the technical, regulatory and financial problems of the Light Water Reactor industry, as well as technical assessments of the accident at Three Mile Island.

Nuclear Waste Technology, funded at $13.3 million, is to develop technologies for treatment of civilian nuclear reactor waste. These activities include technical assistance to the States to develop regional disposal capacities in accordance with the Low Level Radioactive Waste Policy Act, and development of nuclear waste treatment processes suitable for transportation, storage and disposal. The Advanced Nuclear Systems program, funded at $33.5 million, is responsible for the development of a range of nuclear power systems to support specialized military and civilian applications. 1985 activities will support fabrication and assembly of radioisotope thermoelectric generators, and continuance of the space nuclear reactor program. Finally, Civilian Nuclear Waste programs, budgeted for $27.7 million, are intended to support new at-reactor storage technologies, research into alternative methods for permanent storage of high-level waste, and generic R&D studies in support of civilian waste management activities.

Fusion research is slated to receive $483.1 million to support the transition period between the scientific feasibility stage and the product definition stage. Under the product definition stage will be the selection of a plasma core concept for advanced development and use in an advanced engineering device. Currently being considered are the long pulse tokamak and tandem mirror concepts.

Electric Energy Systems research is directed toward determining electric energy field effects, electric network technologies, and new materials to improve the efficiency and productivity of power systems. The FY 1985 budget request for these programs is funded at $18.2 million.

Energy Storage program funding, at $18.9 million, is intended to provide low-cost, efficient, long-lasting, high energy and power electrochemical storage; accelerate development of batteries and electrochemical processes; and transfer energy and resource conserving technologies to industry.

Basic Energy Sciences, supports generic long-term energy related research, including engineering, applied mathematics and the design of advanced computers. In addition to this research, the FY 1985 funds, $419.5 million, will support several important new facilities, including the National Synchrotron Light Source, the Intense Pulsed Neutron Source, the 1.5 MEV high voltage electron microscope, the Atomic Resolution Microscope, and the Stanford Synchrotron Radiation Laboratory. Funding will also continue the Center for Advanced Materials.

The Department of Energy's General Science programs support basic research into fundamental questions of the nature of matter and energy. Its FY 1985 funding of $748.6 million is divided into two program areas. High energy physics, budgeted at $561.0 million, will investigate the fundamental constituents of matter and the fundamental forces of nature to better understand energy and matter and their transformations. The Nuclear Physics programs will receive approximately $183.6 million to investigate the structure and behavior of atomic nuclei.

Fossil fuel R&D will be budgeted at $272.8 million, a 17.2 percent reduction below fy 1984 levels. Research will focus on environmentally sound advanced coal combustion techniques; coal gasification; Magnetohydrodynamics; and new technologies for exploration, development and production of petroleum and gas resources from unconventional sources.

Conservation R&D will receive $168.0 million in FY 1985. Funds will investigate more efficient means of using energy in buildings, manufacturing processes, and transportation, as well as more efficient means of energy conversion and utilization.

University research support and University Research Instrumentation, to be funded at $9.2 million and $6.0 million respectively, are both intended to enhance the quality and opportunities for energy related research at Universities. These funds will provide major state-of-the-art scientific research intrumentation, as well as energy related research and training through reactor fuel assistance, cooperative research, and energy manpower development.

National Aeronautics and Space Administration

Total expenditures for R&D in NASA for FY 1985 should reach $3.466 Billion, a 16.7 percent increase over FY 1984. Foremost amongst new initiatives is the Space Station, funded at $150 million. Work during 1985 will begin a detailed conceptual and engineering definition effort. Research will continue on the Space Shuttle at $142.6 million, focusing on imroving the performance of its propulsion systems.

Under Space Science and Applications, there are several new initiatives, including the Upper Atmosphere Research Satellite ($60.7 million) which is planned for launch in 1989, the Mars Geoscience/ Climatology Orbiter ($16.0 million), to obtain geophysical and geochemical information about Mars,

planned for a 1990 launch. The Physics and Astronomy programs will continue development of the Space Telescope ($195 million), with a 1986 launch date, and the Gamma-ray Observatory ($120.2 million), expected to be launched in 1988. Planetary Exploration will continue the Galileo development ($56.1 million), expected to be launched in 1986 and reach Jupiter in 1988. The Venus Radar Mapper ($92.5) will be both launched and reach Venus in 1988. The Advanced Communications Technology Satellite (ACTS) program budget would be reduced to $5.0 million for both FY 1984 and FY 1985, due to the initiation of similar work by the private sector. Materials Processing in Space research would continue at $23 million.

Aeronautical Research and Technology is budgeted for $342.4 million in FY 1985. Research includes computer science and applications for numerical aerodynamic simulation for complex aerospace computational problems.

Within Space Research and Technology, which is budgeted for $150 million, work will continue in computer science and electronics, and space data and communications.

Finally, $9.5 million has been budgeted for Technology Utilization, intended to accelerate the dissemination of NASA advances in research and technology to both the public and private sectors.

National Science Foundation

Within the NSF, funding for the Engineering Directorate will increase to $147.1 million, 22 percent over 1984 funding. Computer Research within the Mathematical and Physical Sciences Directorate will also increase 15.9 percent to $39.3 million in FY 1985. The Programs of the Science, Technology and International Affairs Directorate will also increase 15 percent to $46.9 million. Science and Engineering Education, on the otherhand, will decrease 14.8 percent to $75.7 million.

Within the Engineering Directorate, Electrical, Computer and Systems Engineering will increase 24.2 percent to $44.7 million. Increased emphasis will be given to microstructure fabrication research, integrated optical devices, automated design, microsensors and robotics for the handicapped. Also, Advanced Scientific Computing will be increased to $5 million to provide increased access to advanced computing facilities. A new initiative in 1985 will be the Centers for Cross-Disciplinary Research in Engineering, funded at $10 million.

These centers are hoped to provide research opportunities to graduate and undergraduate students on industry oriented engineering problems.

Within the Mathematics and Pysical Sciences Directorate, Computer Research will provide $10.3 million for the Foundation-wide initiative on advanced scientific computing. This support contributes to university supercomputer facilities, associated networks, and local facilities.

The Science, Technology and International Affairs Directorate supports programs which overlay the science and engineering directorates. The Industrial Science and Technological Innovation programs would receive $23.4 million in FY 1985, and increase of 33 percent. Support is provided for Industry/University Cooperative Research Projects and Centers ($10 million), Small Business Innovation Research ($6.6 million), and Productivity Improvement research ($1 million). Also within this Directorate is $23.8 million for continuance of the Presidential Young Investigators Research Awards, to support young faculty members with promising academic careers.

Finally, Science and Engineering Education supports Graduate Research Fellowships at a level of $21 million. Precollege Science and Mathematics Education is budget for $54.7 million to support both materials development and research and teacher development and incentives.

Department of Transportation

During FY 1985, the Federal Aviation Administration will allocate $272.1 million to fund Research, Engineering and Development activities. Substantial funding will go to development of advanced automation systems to accomodate post-1990 air traffic requirements, development of advanced communications systems, and modernization of the air traffic control system.

Department of Commerce

Most of the research within the Department of Commerce is conducted by either the National Oceanic and Atmospheric Administration ($166.8 million) or the National Bureau of Standards ($91.2 million). Budgets for both these agencies have been reduced from the current budget year (30.4 and 4 percent respectively).

Funding for NOAA's Satellite Services is intended to convert the geostationary satellite's temperature and moisture sounding capability to an operational system. Also, instrumentation will be developed for geostationary satellites to improve short-term weather forecasts.

The NBS research budget has again been reduced under the Administration's policy of transfering responsibility to the private sector. Under measurement research and standards, it is intended that user fees will cover the expenses associated with the measurement assurance and accreditation service programs. The Institute for Computer Science and Technology is also halved to $5 million.

Chapter 19

R&D in Materials Science and Engineering

Federation of Materials Societies
Stanley V. Margolin (Betsy Houston, coordinator)

This is a continuation of our analysis of the Federal budget to determine the money allocated for Materials Research and Development. This is a follow through from the initial work on the FY84 budget. As we stated in our last report, elements of the budget are so aggregated that to identify all of the Materials R&D would be a hopeless exercise. At this reporting, no information was available for the Department of Defense or the Research and Special Program Administration of the Department of Transportation.

In the FY85 budget for R&D, the Administration proposes to continue reductions in nearer term R&D programs that are not considered an appropriate Federal responsibility and should be left to the States or private sector for appropriate investments. Further, both the Congress and the Administration have continued to focus attention on the particular importance to U. S. economic well being of advancing knowledge and capabilities in the material sciences.

Department of Energy

In FY84 a major new materials initiative was proposed that not only attempts to deal with advanced materials research but also with aspects of training new researchers. This initiative will continue in FY85 and will result in the redirection of the Lawrence Berkeley Laboratory.

In the materials science program, the research is directed towards understanding basic materials phenomena and classes of materials important to energy systems.

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The Center for Advanced Materials will try to accomplish these objectives:

- Establishment of a basic research program strongly oriented toward the solution of technologically important problem with major industrial input and research participation. Heavy emphasis will be placed on the synthesis, characterization and study of the properties of advanced materials.

- Provide advanced facilities for research training of additional graduate students in physical sciences and engineering. The goal of the materials science program is to increase our understanding of phenomena and properties important to material behavior which will contribute to meeting the needs of present and future energy technologies.

  The FY85 request includes the following funds for the core program: $132,110,000 for operating, $13,300,000 for capital equipment and $1,800,000 for construction. For continuation of the initiative on advanced materials research, $9,370,000 is included for operating, $2,150,000 for capital equipment, and $29,920,000 for construction.

Some of the needs to which the materials sciences research ultimately contributes include:

- Developing new or substitute materials.

- Tailoring materials to satisfy defined requirements.

- Predicting materials problem and service life.

- Improving the ability to successfully attack unforseen materials problems in advanced energy systems.

- Improving the theoretical and experimental capability to analyze the fundamental structures of materials.

In summary the table below gives the comparison of FY83, FY84, and FY85:

Thousands of Dollars

	FY1983	FY1984	FY1985
Operating Expenses	$108,163	$125,110	$141,480
Capital Equipment	8,510	12,780	15,450
Construction	3,000	16,440	31,720
	$119,673	$154,330	$188,650

National Science Foundation

The National Science Foundation meets the needs of experimental materials research through the support of university-based centers and facilities such as the materials research laboratories, which permit coordinated multidisciplinary thrusts and require a diversity of scientific and engineering competence. In FY85, materials research increases by $15.5 million to $113.0 million. The major emphasis in materials research will be on strengthening the training of future materials scientists and engineers, particularly in technologically important areas such as electronic materials, ceramics, and polymers. The number of multi-investigator or multi-disciplinary projects supported is increased.

The breakdown of the materials research activity is as follows:

Thousands of Dollars

	FY1983	FY1984	FY1985
Solid State Physics	$8,978	$10,600	$12,220
Solid State Chemistry	6,480	7,670	8,990
Low Temperature Physics	6,216	7,290	8,180
Condensed Matter Theory	6,582	7,610	8,890
Metallurgy	7,803	8,990	10,300
Ceramics and Electronic Materials	4,570	5,550	6,870
Polymers	5,489	6,380	7,570
Instrumentation for Materials Research	3,993	6,470	7,780
Materials Research Labs.	23,428	26,503	30,090
National Facilities	7,540	10,460	12,110
Minerals and Primary Metal Processing	2,079	2,400	2,620
	$83,158	$99,923	$115,620

Department of Commerce

The National Bureau of Standards programs are organized into two major activities, measurement and engineering research and standard and competence and central technical support. The FY85 budget reflects the Administration's evaluation of the NBS program and priorities and reflects the minimum resources necessary to serve industry, government, science and technology.

An important item included is a cold neutron source for materials research which would allow NBS to design and install a unit that will provide a unique capability for measuring the properties, performance and processing of high technology materials.

The budget for these activities is shown below:

	Thousand of Dollars		
	FY1983	FY1984	FY1985
Materials characterization processing and performance	$14,560	$14,937	$17,758

Department of Interior

The U. S. Geological Survey proposes to continue its research on strategic and critical minerals and the assessment, both onshore and offshore, including the Exclusive Economic Zone. These two programs total $28.5 million.

The FY85 Budget for the Bureau of Mines provides resources to support elements of the President's National Materials and Minerals Program Plan and Report to Congress of April 5, 1982. Funds will be provided to continue minerals and materials research aimed at helping to insure adequate domestic supplies of minerals, with emphasis on strategic and critical minerals, by improving and broadening the basic scientific knowledge to support advances in technology that would allow their extraction from domestic deposits, reduce the quantities required in essential application, and permit further recycling of minerals value contained in waste and scrap.

The existing 31 Mineral Institutes and 5 Generic Minerals Technology Centers will have sufficient funds from 1983 and 1984 appropriation to support their program through FY85; consequently no funding is proposed for the Mineral Institute program.

The breakdown for the Department of Interior's budget is:

	Thousands of Dollars	
	FY1984	FY1985
Geological Survey	$141,900	$156,200
Bureau of Mines		
Minerals and Materials Research	30,400	30,900
Conservation and Development	5,800	5,900
	$178,100	$193,000

National Aeronautics and Space Administration

In the Office of Space Science and Applications, the Materials Processing in Space program emphasizes the science and technology of processing materials to understand constraints imposed by gravitational forces and the unique capabilities made possible by controlling these forces in the space environment.

Within this program, ground-based investigations, analysis and studies provides the scientific foundation for all current and future projects. Emphasis is placed on ground-based research which is expected to evolve into space investigations with potential for future applications. This activity also supports technology development for future ground and space capabilities, and commercialization activities leading toward privately funded space enterprises. In FY85, emphasis will continue in the areas of metals and alloys, electronic materials, glass and ceramics, biotechnology, combustion, fluid dynamics and transport phenomena. Research will be conducted to define the role of gravity-driven influences in generic processing methods, and efforts will be continued on establishment of university centers for bioprocessing research and a microgravity research lab. The physics and chemistry experiments in space (PACE) activities also will be funded under this program.

The materials experiment operations program provides a wide range of opportunities for scientific and commercial experiments in microgravity science and applications. FY85 funding will continue basic and applied research activities using Shuttle mid-deck and cargo bay experiments in areas

such as blood storage, isoelectric focusing, crystal growth, and containerless processing.

The funding requirements for these programs are as follows:

	Thousands of Dollars		
	FY1983	FY1984	FY1985
Ground-based Investigations, Analysis and Studies	$13,100	$11,000	$11,700
Materials Experiment Operations	8,90	12,600	11,300
	$22,00	$23,600	$23,000

In the Office of Aeronautics and Space Technology, the aeronautical research and technology program includes funding for materials and structures, emphasizing light alloy metals, new composite materials, high-temperature ceramics for heat engines, and the crash dynamics of composite structures.

Research on high-temperature engine materials will emphasize improved durability and reliability of ceramics, thermal barrier coatings for metal turbine blades, and tough high-temperature polymers. The research effort on conservation of strategic materials will focus on developing new high-temperature materials such as intermetallics to replace superalloys requiring substantial amounts of cobalt, tantalum and chromium. The development of new advanced powder aluminum alloys will concentrate on lightweight alloys. Research on composite materials will continue to place high emphasis on the toughness and durability of highly loaded structures.

The budget requirements for these activities are as follows:

	Thousands of Dollars		
	FY1983	FY1984	FY1985
Materials and Structures Research and Technology	$23,200	$23,200	$25,000

Thus, total materials R&D funds in NASA are:

	Thousands of Dollars		
	FY1983	FY1984	FY1985
Total Materials Funding	$45,200	$46,800	$48,000

Summary

With the exception of the Department of Defense and other agencies where information was not available, the analysis of materials R&D funding shows the following (reliable sources indicate that the total materials R&D budget could be over $1 billion if DOD were included:

	Thousands of Dollars		
	FY1983*	FY1984	FY1985
Materials R&D	$262,591	$494,090	$563,028

*FY1983 does not include Department of Interior data.

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Colloquium Proceedings: 1976 - 1982

From 1976 through 1982, the annual AAAS R&D Colloquia were held in June, following publication of the latest R&D Report. The Proceedings of these Colloquia were published separately each year and, in general, include the full texts of speeches delivered during the meetings and edited versions of the discussions that followed.

Preliminary Analyses: FY 1979 - FY 1984

Prepared by an Intersociety Working Group comprised of representatives of several scientific, engineering and higher education associations, these reports review, in a preliminary fashion, the overall federal budget for R&D, the R&D budgets of several major R&D agencies, and the R&D funding situation in a number of scientific and engineering disciplines. In general, they are published within a few weeks after release of a given year's budget.

Congressional Action on R&D in the Federal Budget: FY 1979 - FY 1984

These brief reports, published in the fall, are also prepared in collaboration with the Intersociety Working Group. They summarize the results of Congressional action on R&D elements in the federal budget. Their format permits comparison between the President's proposals for a given fiscal year and Congressional allocations.

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